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TRANSMITTAL

DATE: March 15, 2013

REFERENCE NO.: 054046

PROJECT NAME: OCC

TO: Mr. Bradley Roberts
U.S. Environmental Protection Agency, Region 7
Air and Waste Management Division
RCRA Corrective Action & Permits Branch
11201 Renner Blvd.
Lenexa, Kansas 66219

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QUANTITY	DESCRIPTION
1	Response to U.S. EPA's Comments on Phase I On-Site Groundwater Investigation Report
2	Copies of Revised Text of the Report and Appendix I (on DVD)

☐ As Requested
☒ For Your Use
☐ For Review and Comment
☐ ______
☐ ______

COMMENTS:

Copy to: M. Kamal
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J. Somoano

Completed by: Bruce Clegg/ko/43
[Please Print]

Signed: B. Clegg

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Mr. Bradley Robert
U.S. Environmental Protection Agency, Region 7
Air and Waste Management Division
RCRA Corrective Action & Permits Branch
901 N. Fifth Street
Kansas City, Kansas 66101

Dear Mr. Roberts:

Re: Response to U.S. EPA's Comments
Phase I On-Site Groundwater Investigation Report
Occidental Chemical Corporation, 6200 S. Ridge Road, Wichita, Kansas
RCRA ID #KSD007482029

Conestoga-Rovers & Associates (CRA), on behalf of Occidental Chemical Corporation (OCC), has prepared responses to the United States Environmental Protection Agency (U.S. EPA) comments detailed in your letter dated February 8, 2013 and received by OCC on February 13, 2013. For ease of your review, U.S. EPA's comments are reiterated below in italic print, followed by CRA's response.

Phase I On-Site Groundwater Investigation Report

1. *In Section 4.2.4, 4th bullet, contains the phrase, "above aqueous solubility results..." Please clarify the meaning of the 4th bullet.*

Response

Each analyte has a maximum solubility in water. If an analyte's concentration exceeds its solubility, it will form a free phase. For analytes that are dense liquids at ambient temperatures, a DNAPL will form. Since the analyte's solubility is generally determined in a laboratory using distilled water at room temperature, there can be some variation in its solubility in groundwater. Each analyte detected in a groundwater sample collected during the on-Site groundwater investigation (i.e., CPT groundwater samples) was compared with its aqueous solubility. If the concentration exceeded the analyte's solubility in water, it would be considered an indication of the presence of DNAPL.

An additional evaluation using 1% and 10% of the aqueous solubility is described in the response to Comment 3 below.

2. *Section 4.6 references Occidental's 2010 report where a capture zone evaluation followed the EPA guidance presented in the document, A Systematic Evaluation of Capture Zones at Pump and Treat Systems", dated January 2008. Sections 4.6.1 and 4.6.2 refer to capture zone re-evaluations performed for this report. In describing the basis for the corresponding conclusions, this report discusses two lines of evidence including observations of contaminant concentrations and contour lines for the groundwater potentiometric surfaces.*

   With respect to utilizing potentiometric surface contour lines to denote capture, the EPA cautions against supposing drawdown and capture are the same; as noted in Figure 6 of the referenced 2008 EPA guidance document. To support conclusions referred to in the report, please discuss the three dimensionality of flow in the vicinity of the pumping wells within each of the two aquifers, whether the pumping wells are fully penetrating, and the depths of piezometers used to measure head. Also present any calculations performed, as discussed beginning on page 19 (Step 4) of the referenced 2008 EPA guidance document.

   Response

   Part One

Section 4.6 has been revised to clearly indicate that this Section was intended to be an interim re-evaluation and not a full "six-step" re-evaluation. The intent was to highlight recent stratigraphic, chemical trend and potential contaminant source information to help in the ongoing analysis of the effectiveness of the groundwater ICM and validate the conclusions from the 2008 evaluation. Section 4.6 summarized this information and identified potential data gaps, and the need, if any, for potential ICM modifications or enhancements.

The key points that this section was intended to make were as follows:

S1 Aquifer

- Chemical concentration trends have remained relatively consistent;
- Off-Site CPT data has defined the limits of the S1 aquifer sand unit to the south, east and west therefore defining the limited downgradient horizontal extent of the aquifer in these directions

S2/S3 Aquifer

- Chemical concentration trends indicate that concentrations of carbon tetrachloride in several S2/S3 monitoring wells located to the east of Hoover Road have been slowly increasing or, in the case of MW138 S2/S3, are now being observed at concentrations above the laboratory detection limit.

- Identification of a potential data gap stemming from the off-Site pumping influences by industrial and agricultural users. Additionally, recent drought conditions in the area are likely resulting in increased pumping from these off-Site wells[1].
- Off-Site CPT data identified the thickening of the S2/S3 aquifer from approximately 20 feet in thickness beneath the OCC Facility to nearly 60 feet in thickness to the south near 71st Street. This thickening of the S2/S3 aquifer to the southeast in the downgradient direction results in a direct increase in the transmissivity of the aquifer which has a direct effect on the capture of the interceptor wells to the south.
- Results from the September 2012 Geoprobe groundwater screening event indicate that COCs detected to the east of the OCC Facility, including carbon tetrachloride, may be emanating from a separate source area located within the DeBruce Grain/Builders Inc. property.

Part Two

The comment regarding using potentiometric surface contours to fully define capture zones is noted and understood.

Table 1 provides a summary of the construction details for the interceptor wells, monitoring wells, and piezometers. The S1 and the S2/S3 aquifers are separated by the C1 clay layer. Two interceptor wells, IW29 and IW36, are extracting groundwater from the deep S1 aquifer. The S1 aquifer is a confined unit and these two interceptor wells are screened over 80 percent of the thickness of the aquifer. In the ICM Effectiveness Report (CRA 2010), vertical gradients were provided for monitoring wells screened in the S1 aquifer and both the lower and upper portions of the S2/S3 aquifer. As indicated by the ICM Effectiveness Report, the predominant vertical gradient calculated was downward from the S2/S3 towards the S1 aquifer. Furthermore, the horizontal limits of the S1 aquifer to the south, east and west have been delineated during Phase I of the on-site groundwater investigation; demonstrating the limited extent of the aquifer in these down and crossgradient directions.

Ten interceptor wells, IW30, IW31, IW32, IW35A, IW35B, IW40, IW41, IW42, IW43, and IW45 are extracting groundwater from the shallow S2/S3 aquifer. The S2/S3 aquifer is generally an unconfined aquifer. The S2/S3 interceptor wells are mostly screened over the lower half of the

[1] All of which could effect the efficacy of the IW system.

aquifer's thickness. In the ICM effectiveness report (CRA 2010), vertical gradients were provided for monitoring wells screened within the lower and upper portions of the S2/S3 aquifer. As indicated by the ICM Effectiveness Report, the predominant vertical gradient calculated was slightly downward within the S2/S3 aquifer. The gradients were steeper closer to the interceptor wells and decline with increasing distances away from these wells.

No additional, aquifer/ capture zone calculations were performed during this interim re-evaluation.

3. *Section 5.2 contains the sentence, "Groundwater analytical results were compared to their aqueous solubility." Please describe the comparison performed.*

Response

The analytical results available in the database for groundwater samples collected from 1990 to the present were compared against 1% and 10% of each analyte's solubility in water. Groundwater concentrations exceeding 1% of an analyte's solubility were considered an indication of a NAPL source, and concentrations exceeding 10% of the aqueous solubility were considered to be an indication of close proximity to a NAPL source.

This analysis was incorporated into the groundwater isoconcentration figures (e.g., Figure 31), which show 1% of the aqueous solubility as a red color.

Additionally, this analysis identified the MW030S3, MW07S1, and the MW016 as anomalous locations (see the response to Comment 4 below).

4. *In Section 5.2.2.3 and in other portions of Section 5, reference is made to sampling locations such as MW030S3, MW07S1, and the MW016 well cluster, noting that at these locations contamination was found with no corresponding source being identified. Please provide a discussion of any and all potential source areas and how well those source areas are delineated with sampling data.*

Response

No unique source has been identified for the concentrations observed in MW030S3, MW07S1, and the MW016 well cluster. However, since the focus of the Phase I investigation was primary (i.e., former process and waste disposal area) on-Site groundwater sources, potential off-Site and secondary sources have not been fully assessed. Regardless, further details on each of the locations identified are provided by the following.

Monitoring well MW030S3 exceeded 10% solubility for carbon tetrachloride, which is an indication of this well's proximity to a DNAPL source. As documented in Appendix E, the likely source of this carbon tetrachloride DNAPL is located in the vicinity of the DeBruce Grain facility. Additionally, these additional data indicate that the trends of increasing carbon tetrachloride concentrations in several S2/S3 monitoring wells located to the east of the OCC Facility are likely the result of a separate DNAPL source.

Monitoring well MW07S1 exceeded 1% solubility for carbon tetrachloride, hexachlorobenzene, hexachlorobutadiene and tetrachloroethene, which is an indication that these analytes may originate from a DNAPL source. Other monitoring wells are located both upgradient and downgradient of this location. The analytes present at MW07S1 are consistent with those detected at the OCC Facility.

Monitoring well cluster MW016 exceeded 10% solubility for pentachlorophenol, carbon tetrachloride, 2,3,4,6-tetrachlorophenol, hexachlorobutadiene; and 1% solubility for 2,4,6-trichlorophenol, and 2,4-D. There have been a number of investigative activities in this area, including cone penetrometer test borings (CPT-012, CPT-024, and CPT 027), Geoprobes (GP-01, 02, 03, 25, 26, 27, 33), and monitoring wells (MW003S1, MW013S1, MW013S3, MW016BR, MW016S1, MW016S1A, MW016S2PVC, MW016S2SS, MW016S4, MW022S1, MW022S2, MW022S4, MW028S1, MW028S2, and MW028S3).

5. *In Section 5.2.5.1 reference is made to 2008 Appendix IX sampling that was performed, and it mentions that dioxins "were generally never observed at this facility as groundwater contaminants." Please provide more discussion on the likelihood of dioxins or other potential contaminants being present as contaminants.*

In revising the report to respond to this comment it is important for Occidental to provide clear documentation on why and how the constituents for which sampling was conducted were selected. Realizing that historical data were used in the selection process as was knowledge of historical production and waste handling; Occidental should describe why certain constituents such as mercury, dioxin, furans, trichlorobenzenes, tetrachlorobenzenes, and 1,4-dioxin were not sampled for.

Response

As previously noted in OCC's response to comments on the Penta Area Phase II report (CRA's letter dated March 7, 2013), a detailed explanation of the development of analyte lists is provided by the following.

The COCs associated with the Site were originally selected in response to item 6 of the 1986 Administrative Order issued by the Kansas Department of Health and Environment (KDHE) (Order). Item number 6 of the Order requested the preparation and submittal of a long-term groundwater monitoring plan. On April 29, 1986, Vulcan Materials Corporation (Vulcan) submitted an updated long-term groundwater monitoring plan to the KDHE. Table A-1 of the monitoring plan provided a list of groundwater monitoring parameters that were identified as chemicals which were potentially released to the environment. The attached Table 2 provides a summary of the parameters from the 1986 monitoring plan along with a generalized chronology of the evolution of the groundwater COC list over the years. As stated in the 1986 monitoring plan, Vulcan developed the parameter list based on the chemical characteristics of past and present production activities and from analyses of products and wastes generated at the facility. (Much of which has been reiterated and expanded upon as an integral part of the various RFI work plans and reports recently submitted but has not been duplicated herein.)

After OCC's acquisition of the Site in 2005, the U.S. EPA raised concerns regarding the comprehensiveness of the groundwater monitoring program COC list of parameters for upcoming RCRA Facility Investigations (RFI) and Corrective Measures Studies (CMS). To address these concerns, OCC reviewed their process chemistry and chemical inventories, and performed a baseline groundwater monitoring program to identify potential additional COCs that should be included in the subsequent investigations/studies. In June and July 2008, a Site-wide baseline groundwater sampling event was completed wherein groundwater samples were collected from approximately 135 monitoring wells and analyzed for the RCRA Appendix IX[1] parameter list along with the routine (at that time) COC list parameters that were not Appendix IX analytes. The results from this monitoring event were presented in the *Appendix IX Semi-Annual Groundwater Monitoring Report* dated October 2008. Based on a thorough review of the resultant Appendix IX analytical results and ongoing discussions with the U.S. EPA, three additional parameters were added to the groundwater COC list

[1] Appendix IX parameters refers to the parameters listed in 40 CFR Part 264 Appendix IX-Ground-Water Monitoring List.

embraced prior to that point. The three additional parameters were delta-hexachlorocyclohexane (delta BHC), 1,2-dichloropropane (1,2-DCP) and 2,4-dichlorophenoxyacetic acid (2,4-D). Therefore, the current COCs listed in the far right hand column of Table 4 are based on a thorough evaluation of historical plant production and waste generation activities, the evaluation of historical analytical results, the results of the 2008 Appendix IX baseline sampling event and ongoing discussions with the U.S. EPA.

Validation of the current COC list was established through the Phase I investigation of the Alpha Cake Landfill, Hex Waste Pits, and Brine Ponds RFI which included the collection and analyses of leachate and soil samples for Appendix IX parameters. An evaluation of the results was presented in a February 19, 2010 letter (final) to EPA which concluded that the routine COC list of parameters were detected at the greatest frequencies and concentrations, and that, although a few non-routine parameters were detected, these were insignificant when compared to the routine COCs. Further, the other detected compounds (outside of the "routine" list) were daughter compounds of those in the routine COC list and the total extent and level of impact would be fully evident from the use of the routine list for Phase II activities. OCC received acceptance of this approach from the U.S.EPA in a February 19, 2010 approval letter of the Phase II recommendations.

The current COC list is referred to in several of the subsequent RFI-related reports as the "Site-Specific" or "routine" COCs. This COC list represents the baseline COC list in each of the subsequent U.S. EPA-approved RFI work plans submitted since the end of 2008 with the exception of the Fuel Depot RFI Work Plan[1]. In addition, the COC list in several of the approved RFI work plans such as the Landfill (discussed above), Stormwater Ponds, Inorganics, and Arkema RFI work plans included several additional parameters at the specific request of the U.S. EPA. Specifically, the Inorganics Area RFI Work Plan, which was approved by the U.S.EPA on August 5, 2010, included asbestos sampling at SWMUs and in those areas where asbestos or asbestos-containing wastewaters were handled. The Arkema Investigation Work Plan (CRA September 2011) utilized the routine COC list for the borings but also included additional parameters beyond the routine COC list, namely refrigerants and PAHs, and was approved by the U.S.EPA on November 14, 2011. The Stormwater Ponds RFI Work Plan (CRA August 2012) included dioxin/furan analysis for samples located near the ponds.

[1] The COC list in the work plan was consistent with Table 3.1 Chemicals of Concern for Difference Product Releases: Kansas Risk-Based Corrective Action for Petroleum Storage Tanks Sites (KRDCA Manual: dated July 2011).

Monitoring parameters for the Fuel Depot RFI, meanwhile, focused on fuel-related analytes as set out by the KDHE for petroleum storage tank sites[3].

The RFI program primarily embraced the "routine" COCs based on facility process and waste production knowledge with subsequent modifications based on an evaluation of historical data and comprehensive monitoring (e.g., Appendix IX). Nevertheless, RFI monitoring requirements were tailored (with U.S. EPA concurrence) to the operational and waste handling history of the area being investigated, that is, monitoring parameter selection was not based on a "one size fits all" philosophy

The following discussion is intended to address the U.S. EPA's request for a description of why certain constituents such as mercury, dioxin, furans, trichlorobenzenes, tetrachlorobenzenes, and 1,4-dioxane were not included in the analyses. Further details are provided by the following.

Mercury: Chlor-alkali processes can be performed using mercury cells, membrane cells, or diaphragm cells. Mercury cells have never been used at the Wichita facility. The Wichita facility's chlor-alkali plant utilizes (and has always utilized) membrane and diaphragm techniques for the production of caustic (sodium hydroxide), chlorine gas and hydrogen. These processes do not utilize mercury. In addition, the Facility did not utilize mercury or mercury compounds for any of the other organic or inorganic chemical processes adopted by the Facility. Moreover, a review of the analytical database for mercury identified 143 records that indicate that the majority of the results were non-detections. In the few samples in which mercury was detected, the detections were well below the MCL for groundwater or the RSLs for soils. On these bases, mercury is not a COC at this Site.

Dioxins and Furans: In response to a 2009 comment on the Landfill RFI Work Plan, CRA conducted a review of the Facility's hex waste incineration process that identified that chlorinated dioxin and furan formation during the process was very unlikely to occur. The evaluation noted that the temperature was too high to allow the formation of chlorinated dioxins and furans. Specifically, the generation of dioxins from solid phase carbon and oxygen (De Novo synthesis) occurs primarily between 200 and 400 degrees centigrade (Littarru and Vargiu, 2003). In contrast, the hex waste incinerator operated at a temperature greater than 1,000°C. The chemical production processes at the facility that involve chlorination are performed in the absence of oxygen (dioxins and furans both contain oxygen). Moreover, of the over 2,200 dioxin and furan analyses completed during the 2008 Appendix IX monitoring event only one sample had a detectable concentration of one dioxin species at less than 1 ppb. Furthermore, during the 2009 landfill investigation, leachate and subsurface soil samples were collected for dioxin/furan analysis and these compounds were not detected. The 2012 investigation of the stormwater ponds included the collection of subsurface samples analyzed for dioxins and furans, and these were not detected. On these bases, no dioxin or furan species are a COC at this Site.

Trichlorobenzenes and Tetrachlorobenzenes: Trichlorobenzenes and tetrachlorobenzenes and their related isomers could be generated in trace quantities as waste products (resulting from the incomplete chlorination) during the gamma-BHC production process. However, the volume of trichlorobenzenes and tetrachlorobenzenes with respect to the volume of alpha, beta and delta BHC waste generated during the gamma-BHC production process would generally be considered insignificant[1]. Moreover, during the 2008 Appendix IX monitoring event 1,2,4,5-tetrachlorobenzene was not detected in any of the samples and 1,2,4-trichlorobenzene was only detected in one sample (MW29S2) at a concentration well below the groundwater criteria. Furthermore, during the 2009 landfill investigation, leachate and subsurface soil samples were collected. 1,2,4,5-tetrachlorobenzene was not detected in any of the samples and 1,2,4-trichlorobenzene was only detected in one leachate sample (HX-4) at a concentration well below the groundwater criteria. The database did identify that 1,2,4-trichlorobenzene was detected in one soil sample collected in 1987. On these bases, neither trichlorobenzenes nor tetrachlorobenzenes are COCs at this Site.

1,4-dioxane: In evaluating the potential presence of 1,4-dioxane contamination in the groundwater, a February 12, 2003 letter to the U.S. EPA on this subject was considered. To that end, it was confirmed that 1,4-dioxane is used as a stabilizer in commercial grades of 1,1,1-trichloroethane[2] and that neither 1,4-dioxane nor 1,1,1-trichloroethane had ever been produced at the Wichita Facility. However, 1,1,1-trichloroethane, which Vulcan sold as a trademarked product "Solvent 111", was produced at its Geismar, Louisiana plant. At certain times in the past, the Wichita plant received "railcar" quantities of Solvent 111, stored the material in an aboveground storage tank, and undertook truck and drum shipments to regional customers. This process occurred, as business demanded, from the late 1970's to the middle 1990's. The Solvent 111 (general purpose grade) produced at the Geismar plant contained 2.2% by weight 1,4-dioxane. During the 2008 Appendix IX monitoring event, 1,4-dioxane was not detected in the approximately 135 samples collected. However, during sampling events completed in 2003 and 2007, 1,4-dioxane was detected in five groundwater samples at concentrations

[1] Alpha, beta, delta and gamma BHC are considered primary COCs of the RFI
[2] 1,1,1-trichloroethane is on the current COC list.

but these detections were insignificant when compared to detections of the routine COCs. Furthermore, during the 2009 landfill investigation, leachate and subsurface soil samples were collected and 1,4-dioxane was not detected in any of the samples. On these bases, 1,4-dioxane is not a COC at this Site.

6. *Section 5.3 refers to "residual saturation levels." Please clarify the meaning of this phrase in the context of this section.*

Response

The potential for a DNAPL body to expand or migrate is dependent upon the amount of pore space which is saturated with DNAPL (as opposed to air or water) and the weight of the DNAPL column above it. DNAPL bodies tend to expand or migrate until the pore pressure is insufficient to induce further expansion. Over time, the pore space that is saturated with DNAPL decreases as the expansion reaches its maximum extent. At the Wichita facility, the DNAPL is likely associated with plant operations/waste management practices prior to implementation of the 1977 facility waste management improvements. Because of the time elapsed, it is likely that the DNAPL has reached (or is approaching) its maximum extent.

A DNAPL mobility and recoverability study is proposed for the Phase II RFI to provide a detailed evaluation of this topic.

7. *Section 6.1.1, in the 6th bullet, refers to the "standard Site COC list of parameters." The report contains multiple tables of COC lists; however, as there is no table with that title, please indicate the whereabouts of that list.*

Response

Please refer to the response to Comment 5.

8. *Figures 23-36, 38-43, 45-53, 55-63, and 65-68 illustrate distributions of particular contaminants; but in order to support the isoconcentration contours depicted, they also need to show sample locations and detections. Additionally, please identify the RSL for the specific contaminant being mapped.*

Response

Agreed. The revised report includes an appendix which provides isoconcentration maps with sample locations and analytical results for each analyte[1]. The relevant RSL or MCL is indicated on each figure.

9. *With regards to figures such as Figure 61; Occidental should describe in the text of the report possible reasons such as nutrients or co-contaminants that might cause contaminant breakdown/alteration in certain portions of the plume that could result in irregular plume shapes like those presented. The report points out that groundwater flow directions have changed over the years, which has caused extensions of plumes in multiple directions; likewise, if Occidental suspects such plume shapes are attributable to multiple sources please discuss this as well.*

Response

Acknowledged. The report has been revised to better incorporate these topics. However, since the focus of the investigation was primary (i.e., former process and waste disposal area) on-Site groundwater sources, potential off-Site and secondary sources have not been fully assessed.

Figure 61 shows the groundwater isoconcentrations for beta-BHC. In general, gamma-BHC (Lindane) can degrade to alpha-BHC, and alpha-BHC can degrade to beta-BHC. All the BHC isomers can degrade to non-BHC compounds, and ultimately mineralize. Beta-BHC is generally considered the most persistent isomer in the environment. It appears unlikely that the eastern plume shown on Figure 61 has separated from the plant area plume due to degradation or any other attenuation mechanism. The eastern plume likely originates from a location that is independent from the plant under the current or any known historic flow regime.

10. *This report identifies plumes of different contaminants and summarizes distribution of contaminants in soil and groundwater, which is necessary to determine future monitoring protocols. Comparison of the report figures shows that plumes of these contaminants are covering some of the same areas, but only in a limited sense does it*

[1] The figures in the main body of the report will remain unchanged because the large number of analytical results cannot be displayed without detracting from the graphic information already displayed. The figures with the sample locations and results (as requested by U.S. EPA) are provided electronically for ease of reproduction at any size.

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& ASSOCIATES

describe the results in terms of summarizing the contaminants from suspected source areas or SWMUs. As mentioned in comment number 4 above, some contamination is apparent without identifying what source/source area it came from. To strengthen the conceptual site model, please provide a discussion from this perspective, perhaps in Section 5.3 or Section 6.0.

Response

Acknowledged. Also please see the response to U.S. EPA's comments 4 and 9. A SWMU-specific evaluation is currently ongoing, the results of which are intended to be incorporated into the phase II on-site groundwater investigation report.

Should you have any questions on the above, please do not hesitate to contact us.

Yours truly,

CONESTOGA-ROVERS & ASSOCIATES

B Clegg

Bruce Clegg

BCC/lg/8

cc: Mostafa Kamal (KDHE)
Lisa Blair (OCC)
Juan Somoano (GSHI)

PHASE I ON-SITE GROUNDWATER INVESTIGATION
RCRA FACILITY INVESTIGATION (RFI)
SUMMARY REPORT

GLENN SPRINGS HOLDINGS, INC.
OCCIDENTAL CHEMICAL CORPORATION FACILITY
WICHITA, KANSAS

Revision 1 (March 15, 2013)

Prepared by:
Conestoga-Rovers & Associates

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MARCH 2013
REF. NO. 054046 (36)
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LIST OF ACRONYMS

2,4-D	2,4-dichlorophenoxyacetic acid
AOC	Area of Concern
bgs	below ground surface
BHC	benzene hexachloride (see HCH)
CAS	Continental Analytical Services
CFC	chlorofluorocarbon
CMS	Corrective Measures Study
COC	contaminants of concern
CPT	cone penetrometer test
Csat	soil saturation limit
CSM	conceptual site model
DNAPL	dense non-aqueous phase liquid
DPT	direct push technology
EC	electrical conductivity
FID	flame ionization detector
Frontier	Frontier Chemical Company
GAC	granular activated carbon
gpm	gallons per minute
HCH	1,2,3,4,5,6-hexachlorocyclohexane (a/k/a benzene hexachloride or BHC)
HSWA	Hazardous and Solid Waste Amendments
ICM	Interim Corrective Measures
IW	interceptor well
KDHE	Kansas Department of Health and Environment
Lindane	gamma-BHC (greater than 99% gamma-BHC isomer)
LNAPL	light non-aqueous phase liquid
MCL	Maximum Contaminant Level
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
Murray Gill	Westar Energy Inc. Murray Gill Energy Center
NAPL	non-aqueous phase liquid
NESHAP	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
OCC	Occidental Chemical Corporation
PCE	perchloroethylene (a/k/a perchloroethene, tetrachloroethene, or tetrachloroethylene)
Phase I	First Investigative Phase
Phase II	Second Investigative Phase
PID	photoionization detector
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RSK	Risk-Based Standards for Kansas
RSL	Regional Screening Levels

LIST OF ACRONYMS

SAP	Sampling and Analysis Plan
SMCL	Secondary Maximum Contaminant Level
SWMU	solid waste management units
TDS	total dissolved solids
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TSCA	Toxic Substances Control Act
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
VCI	Voluntary Cleanup Investigation
VCRU	Vent Capture and Recovery Unit
VFS	Vulcan Feed Stock
VOCs	volatile organic compounds
Vulcan	Vulcan Materials Company
Work Plan	On-Site Groundwater RCRA Facility Investigation (RFI) Work Plan (CRA 2012b)

1.0 INTRODUCTION

This report summarizes the investigative activities and data obtained during the first phase of the On-Site Groundwater Investigation completed at the Occidental Chemical Corporation (OCC) Wichita Facility (Facility or Site) located at 6200 S. Ridge Road, Wichita, Sedgwick County, Kansas. The Site location is provided as Figure 1. The investigation was conducted in accordance with the On-Site Groundwater Investigation RCRA Facility Investigation (RFI) Work Plan (CRA 2012b) (Work Plan). In addition to the Phase I On-Site Groundwater Investigation findings, this report presents the January 2012 Phase III Landfill Investigation data along with the September 2012 Geoprobe Groundwater Screening Investigation (implemented to the east and southeast of the Facility) data.

The investigative findings documented herein have been utilized in conjunction with the myriad of other Site data to 1) provide a broader evaluation of contaminant distribution as it relates to past and present Site operations and potential sources of groundwater contamination; 2) refine the conceptual site model (CSM) based on the additional stratigraphic information garnered from this program; 3) evaluate the ongoing effectiveness of the groundwater Interim Corrective Measures (ICM); and 4) develop specific recommendations for Phase II activities and supplemental groundwater ICM measures in the context of the fully evaluated dataset. All of these items are fully discussed by this report.

The investigative activities were conducted in association with the generalized Area of Concern (AOC) known as "On-Site Groundwater" as set out by the RFI Schedule. A brief summary of information known about this AOC is also included herein. However, a detailed summary of historical information regarding previous groundwater investigations and groundwater ICMs is provided in the report entitled Interceptor Well System Interim Corrective Measures Effectiveness Evaluation, dated February 11, 2010 (CRA 2010a).

The scope of work for this AOC embraces a phased approach whereby the first phase (Phase I) included both a biased plan {focused on known or suspected dense non-aqueous phase liquid (DNAPL) areas} and a regular, systematic grid investigation. In this way, both known areas of potential high contaminant concentrations were explored in combination with previously uninvestigated areas. The proposed scope of the second investigative phase (Phase II), detailed herein, is based on the compiled Phase I data utilized in conjunction with existing Site data.

The specific objectives for Phase I of the on-Site groundwater investigation were to:

- Identify and delineate areas where DNAPL had previously been identified.
- Further define the subsurface geology beneath the main facility area of the Site.
- Further define the groundwater quality beneath the main facility area of the Site.
- Further define the subsurface geology in the areas surrounding the Site.

2.0 SITE BACKGROUND

2.1 FACILITY BACKGROUND

The Facility is located on approximately 160 acres of land in Sedgwick County, Kansas, approximately 5 miles southwest of the City of Wichita. OCC also owns additional land adjacent to the operating Facility. The Facility is located in a rural industrial, agricultural farming, and ranching area. The Facility location is provided on Figure 1, and the Facility layout is provided on Figure 2.

Address	6200 S. Ridge Road, Wichita, Sedgwick County, Kansas 67215
Latitude-Longitude	37.582197, -97.42293
Public Land Surveying System	Township 28 South, Range 1 West, Section 27, Southwest quarter section

2.1.1 OPERATIONAL HISTORY

Prior to 1951, the Site consisted of agricultural land transected by the Missouri Pacific Railroad.

The Frontier Chemical Company (Frontier) was organized in 1951 and began construction of a chlor-alkali plant at the Site. Around the same time, the Tennessee-Frontier Corp.[1] began construction of a pesticide production facility adjacent to the chlor-alkali plant. Frontier and Tennessee-Frontier began production of chlorine, sodium hydroxide, hydrochloric acid, and benzene hexachloride (BHC)[2] at the Facility in 1952. The Tennessee-Frontier facility was purchased by Frontier in 1953.

On December 23, 1954, Frontier and the Consumers Company merged into the Follansbee Steel Corporation and became the Union Chemical and Material Corporation.

[1] The Tennessee-Frontier Corp. was reportedly a joint venture between Frontier, the Tennessee Products and Chemical Corp., and Colorado Fuel and Iron Corp.

[2] Although 1,2,3,4,5,6-hexachlorocyclohexane is the current preferred chemical nomenclature {based on the International Union of Pure and Applied Chemistry (IUPAC) systematic name}, the term benzene hexachloride or BHC will be used in this report to reflect the nomenclature historically used at the Facility (and throughout the industry).

The Vulcan Materials Company (Vulcan) purchased the Union Chemical and Material Corporation on December 31, 1957. At the time of purchase, the Facility was producing chlorine, caustic soda, hydrochloric acid, Lindane, 2,4-dichlorophenoxyacetic acid (2,4-D), pentachlorophenol, and various chloromethanes (methylene chloride, chloroform, and carbon tetrachloride).

In 1958, Vulcan began producing perchloroethylene (PCE).[3] The following year, in 1959, Vulcan ceased 2,4-D production and began producing anhydrous hydrochloric acid. In 1960, Vulcan added a sniff gas[4] recovery section to the chlorine plant. In 1962, Vulcan ceased operations at the BHC plant and constructed an ammonia plant, and expanded the ammonia plant in 1965.

In 1972, Vulcan constructed a caustic bead plant, followed by a methyl chloride plant the following year.

In 1977, Vulcan opened the chloromethanes II plant to increase production of chloroform, carbon tetrachloride, methylene chloride, and methyl chloride gas.

In 1990, Vulcan committed to reducing hazardous emissions at its chemical plants by 90 percent over the next 5 years, primarily by reducing hydrochloric acid disposal amounts. Hydrochloric acid was utilized in the calcium chloride plant which commenced operations in 1993. The calcium chloride plant was subsequently closed in 2002.

In 1992, Vulcan ceased production at the chloromethanes I plant and in 1994 the caustic bead plant was closed. In 1995, Vulcan closed the anhydrous hydrochloric acid plant due to a lack of demand for this product.

In 1996, Vulcan closed the perchloroethylene plant due to a decrease in demand. At that time, Vulcan also installed a Vent Capture and Recovery Unit (VCRU) in order to comply with the Hazardous Organic National Emission Standard for Hazardous Air Pollutants (NESHAP) regulations. The Sodium Chloride Plant was started up for production of a liquid form of sodium chloride and a dry form remains in operations today.

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[3] Perchlorethylene is synonymous with perchloroethene, tetrachloroethene, and tetrachloroethylene; and is commonly referred to simply as "perc." Perchloroethylene is commonly abbreviated as PCE.

[4] "Sniff gas" can refer to any gas containing impure chlorine, such as the gas from empty chlorine tank cars or storage tanks (the sniff gas is recovered by displacement when the tank is filled). Sniff gas typically contains 10 to 80% chlorine, with some nitrogen and oxygen.

In 1997, Vulcan began operation of the Vulcan Feed Stock (VFS) plant. The VFS plant produced chlorinated propane intermediates that were used in manufacturing of a 3rd generation refrigerant product. The VFS plant was subsequently closed in 2002.

In June 2005, OCC purchased the Facility from Vulcan. Pentachlorophenol production at the Facility was ceased in June 2005.

As of the date of this report, the OCC Wichita Facility manufactures chlorine, caustic, hydrogen, sodium chlorite, hydrochloric acid, methylene chloride, methyl chloride, chloroform, and carbon tetrachloride.

2.1.2 HISTORICAL WASTE DISPOSAL

When Vulcan acquired the Site in 1957, wastewater from chemical production was discharged to deep injection wells and off Site to adjacent drainage ditches while solid wastes were disposed of in an on-Site landfill located east of the railroad tracks.

The Facility manufactured BHC pesticides from 1952 until 1962. The "alpha-cake" waste generated from this process consisted principally of alpha-BHC, with lesser amounts of the beta-, delta-, and gamma-BHC isomers. The waste was routinely disposed of in the alpha cake portion of the on-Site landfill (also known as the Alpha Cake Landfill).

The Facility manufactured perchloroethylene from 1958 until 1996. Wastes generated in this production process included hexachlorobenzene, hexachlorobutadiene, hexachloroethane, and other chlorinated organic compounds (collectively called "hex wastes"). Hex waste handling included consolidation in pits to cool and solidify, and subsequent disposal of the solidified material in the hex waste trench portion of the on-Site landfill prior to its closure in 1977. In addition to hex wastes, other materials including "off-spec" products, spill materials, and barrels may have been placed in the hex waste portion of the landfill. After closure of the on-Site landfill, hazardous and non-hazardous solid wastes were incinerated or shipped to permitted off-Site disposal facilities.

In 1997, the former perchloroethylene production area was used to produce a 3rd generation refrigerant precursor and the area was referred to as VFS (Vulcan Feed Stock). The plant used chlorinated propanes in the manufacturing process. The plant generated two liquid waste streams and one solid waste stream that were comprised of chlorinated solvents and trash/debris. These waste streams were sent off Site for incineration. This plant was closed in 2002 and the area has remained moth-balled since 2002.

Wastes generated during water softening processes at the plant were placed into a solar pond which was located west of the railroad tracks in the northeastern portion of the inorganics area. The former brine ponds located east of the railroad tracks received overflow from the solar pond. When the solar pond was closed in 1971, the contents were placed within the brine ponds area which was subsequently closed by capping in 1977. The solar pond and brine ponds primarily received calcium carbonate and magnesium hydroxide but may have also received brine water, hydrochloric acid, sulfuric acid, and potentially other non-organic liquids.

The chloromethanes I plant was operating when the Facility was purchased in 1957 by Vulcan and was the original manufacturing process plant for methane-based chlorinated organic compounds. Specifically, this plant formerly manufactured methylene chloride, chloroform, and carbon tetrachloride. The plant closed in 1992. Waste generated at this plant may have included cooling tower water, caustic, trace organics (chlorosolvents), trace chlorine, lubricating oils, hydrochloric acid, and sulfuric acid.

The chloromethanes II plant began operation in 1977. This plant increased the production of chloroform, carbon tetrachloride, and methylene chloride. In addition to the liquid chlorosolvents, the chloromethanes II plant manufactures a gas, methyl chloride. A mixture of chlorosolvents is the predominant waste stream of the chloromethanes II plant. Disposal of the chlorosolvent production-related wastewater is undertaken using the deep well injection system, and solid hazardous waste streams are disposed of utilizing an off-Site permitted disposal facility.

Current Facility disposal practices consist of off-Site shipment to permitted disposal facilities for hazardous and non-hazardous solid wastes. Disposal of wastewaters is performed using the deep well injection system.

2.1.3 OVERVIEW OF HISTORICAL INVESTIGATIONS AND CORRECTIVE ACTIONS

The Facility began operations in 1952. Beginning in 1955, several on-Site production wells were closed due to hardness and chloride contamination. In 1960, a study of salt contamination was performed at the Westar Energy, Inc. Murray Gill Energy Center (Murray Gill) located to the northeast of the Site. This was the first in a series of groundwater investigations performed at and near the Site.

In 1971, organic contamination was identified in on-Site production wells. In 1972, two production wells and a monitoring well were used as groundwater extraction wells. A groundwater study was performed by the Layne-Western Company (Layne 1972).

In 1976, the Resource Conservation and Recovery Act (RCRA) was promulgated. Vulcan implemented significant pollution control measures in 1977, including improvement in the segregation of stormwater from wastewaters, installation of sump pumps in each process area to control wastewater flow, construction of above ground process wastewater lines for early leak detection, and the development of a rainwater collection system (Vulcan 1977). These measures were implemented in accordance with the 1976 Waste Management Control Program Report (Wilson 1976). In addition, the on-Site hex waste pits and alpha cake landfill were closed and capped. The brine ponds located immediately north of these areas were also capped. Vulcan implemented an interim remedial measure to hydraulically contain impaired groundwater by placing three interceptor wells (IW30, IW31, and IW32) along the southern boundary of the closed hazardous waste landfill, one interceptor well (IW29) along the southern boundary of the production facility, and two interceptor wells (IW33 and IW34) along the eastern boundary of the closed hazardous waste landfill area. IW35A and IW35B were installed shortly thereafter along the southern boundary if the facility towards to west. These wells provided a hydraulic barrier to limit the migration of contaminated groundwater.

In 1984, the Hazardous and Solid Waste Amendments (HSWA) were passed.

In 1986 and 1987, the United States Environmental Protection Agency (USEPA) conducted a RCRA Facility Assessment (RFA) at the Site. In May 1987, an RFA Report was completed. The RFA determined that releases, potentially including off-Site releases, of hazardous materials had occurred at the Facility. Based on the results of the RFA, the USEPA requested that Vulcan perform additional monitoring of groundwater and extensive sampling of off-Site soils.

In 1987, and as summarized within the Canonie Environmental Closed Landfill Evaluation Report dated 1988, an investigation was completed in the alpha cake landfill and hex waste pits areas.

A new HSWA operating permit became effective in November 1989.

An RFI was performed for off-Site soil and groundwater in 1991-1996. The RFI for off-Site soil and groundwater was submitted to the USEPA in November 1996.

The renewal of the HSWA operating permit became effective on February 18, 1993, which required a Corrective Measures Study (CMS) work plan for groundwater. A CMS for off-Site groundwater was performed in 1994-1997.

In 2003, Vulcan installed four additional interceptor wells (IW36, IW40, IW41, and IW42).

In 2006, a draft RFI Work Plan was submitted to the USEPA which included the proposed investigation of all AOCs and solid waste management units (SWMUs) at the Facility. This RFI Work Plan was reviewed by the USEPA but was never finalized.

In 2010, two additional interceptor wells IW43 and IW44 were installed southeast of the Facility in the area that is currently known as the Prairie Wetlands Conservation Area (PWCA).

A new RCRA Hazardous Waste Management Facility Renewal Permit for the Facility became effective on July 30, 2007.

In 2008, an RFI Schedule of Work was agreed upon between the USEPA and OCC. For the investigations that involved the collection of field samples, work plans outlining the scope of work for each AOC were developed and submitted to the USEPA for review and approval. Field activities were initiated following approval of the work plans by the USEPA. Reports were then prepared to summarize the RFI investigation work completed and to present the resultant data. The following documents were developed in association with the investigations conducted under the RFI:

- Work Plan, Soils Gas Sampling, Occidental Chemical Corporation, Wichita, Kansas, Shaw Environmental, Inc. (Shaw 2007)
- Interim Corrective Measures Implementation Report for Asbestos Surface Impoundment SWMU, Occidental Chemical Corporation, Wichita, Kansas, Weston Solutions, Inc. (Weston 2008)
- Work Plan for Indoor Soils Gas Sampling, Occidental Chemical Corporation, Wichita, Kansas, Shaw Environmental, Inc. (Shaw 2008)
- Appendix IX Semi-Annual Groundwater Monitoring Report, Glenn Springs Holdings, Inc., Occidental Chemical Corporation Facility, Wichita, Kansas (CRA 2008)

- Quality Assurance Project Plan, Facility-Related Investigative Activities, RCRA Corrective Action Program, Occidental Chemical Corporation Facility, Wichita, Kansas, EPA ID No. KSD007482029 (CRA 2009d)
- Site-Specific Health and Safety Plan, Occidental Chemical Corporation, Wichita, Kansas (CRA 2009c)
- Sampling and Analysis Plan, Facility-Related Investigative Activities, RCRA Corrective Action Program, Occidental Chemical Corporation, Wichita, Kansas, EPA ID No. KSD007482029 (CRA 2009a)
- Interceptor Well System, Interim Corrective Measure, Effectiveness Evaluation, Glenn Springs Holdings, Inc., Occidental Chemical Corporation Facility, Wichita, Kansas (CRA 2010a)
- Alpha Cake Landfill, Hex Waste Pits and Brine Ponds, RCRA Facility Investigation (RFI) Work Plan, Glenn Springs Holdings, Inc., Occidental Chemical Corporation Facility, Wichita, Kansas (CRA 2009b)
- On-Site Vapor Intrusion Investigation, Assessment, and Interim Corrective Measures Implementation, Glenn Springs Holdings, Inc., Occidental Chemical Corporation Facility, Wichita, Kansas (CRA 2009e)
- Phase I Summary/Phase II Recommendations, Alpha Cake Landfill, Hex Waste Pits, and Brine Ponds RFI, Occidental Chemical Corporation Facility, Wichita, Kansas (CRA 2010b)
- Penta Area and Shipping RCRA Facility Investigation (RFI) Work Plan, Glenn Springs Holdings, Inc., Occidental Chemical Corporation Facility, Wichita, Kansas (CRA 2010c)
- Inorganics Area RCRA Facility Investigation (RFI) Work Plan, Glenn Springs Holdings, Inc., Occidental Chemical Corporation Facility, Wichita, Kansas (CRA 2010d)
- RFI Summary Report Alpha Cake Landfill, Hex Waste Pits, and Brine Ponds, Glenn Springs Holdings, Inc., Occidental Chemical Corporation Facility, Wichita, Kansas (CRA 2010f)
- Operation and Maintenance Plan for On-Site Vapor Intrusion Interim Corrective Measures at the Control Laboratory, Technical Center and Administration Building, Glenn Springs Holdings, Inc., Occidental Chemical Corporation Facility, Wichita, Kansas (CRA 2010e)
- Off-Site Supplemental Quarterly Soil Gas Monitoring Summary Report, Glenn Springs Holdings, Inc., Occidental Chemical Corporation Facility, Wichita, Kansas (CRA 2011b)

- Penta Area and Shipping RCRA Facility Investigation (RFI) Summary Report, Glenn Springs Holdings, Inc., Occidental Chemical Corporation Facility, Wichita, Kansas, Revision 3 (CRA 2011h)
- Inorganics Area RCRA Facility Investigation (RFI), Glenn Springs Holdings, Inc., Occidental Chemical Corporation Facility, Wichita, Kansas (CRA 2011d)
- Operation and Maintenance Plan for On-Site Vapor Intrusion Interim Corrective Measures at the Control Laboratory, Technical Center and Administration Building, Glenn Springs Holdings, Inc., Occidental Chemical Corporation Facility, Wichita, Kansas, Revision 1 (CRA 2010g)
- Conceptual Design Summary Groundwater ICM Modification, Glenn Springs Holdings, Inc., Occidental Chemical Corporation Facility, Wichita, Kansas, Revision 2 (CRA 2011e)
- Chloromethanes I, II, Perc and Hazwaste Areas RCRA Facility Investigation (RFI) Work Plan, Glenn Springs Holdings, Inc., Occidental Chemical Corporation Facility, Wichita, Kansas, Revision 1 (CRA 2011g)
- On-Site Vapor Intrusion Mitigation Interim Corrective Measures Construction Completion Report, Glenn Springs Holdings, Inc., Occidental Chemical Corporation Facility, Wichita, Kansas, Revision 1 (CRA 2011f)
- Arkema Area Investigative Work Plan, Glenn Springs Holdings, Inc., Occidental Chemical Corporation Facility, Wichita, Kansas, Revision 2 (CRA 2011i)
- On-Site Groundwater Investigation RCRA Facility Investigation (RFI) Work Plan, Glenn Springs Holdings, Inc., Occidental Chemical Corporation Facility, Wichita, Kansas, Revision 2 (CRA 2012b)
- Sampling and Analysis Plan Routine Groundwater Sampling Plan RCRA Corrective Action Program, Occidental Chemical Corporation, Wichita, Kansas, EPA ID No. KSD007482029, Revision 2 (CRA 2012a)
- Stormwater Ponds Area, RCRA Facility Investigation (RFI) Work Plan, Glenn Springs Holdings, Inc., Occidental Chemical Corporation Facility, Wichita, Kansas, Revision 1 (CRA 2012e)
- Fuel Depot Area, RCRA Facility Investigation (RFI) Work Plan, Glenn Springs Holdings, Inc., Occidental Chemical Corporation Facility, Wichita, Kansas, Revision 1 (CRA 2012f)
- Chloromethanes I, II, Perc And Hazwaste Areas RCRA Facility Investigation (RFI) and Arkema Area Investigation Summary Report, Glenn Springs Holdings, Inc., Occidental Chemical Corporation Facility, Wichita, Kansas (CRA 2012c)

- Penta Area and Shipping Phase II RCRA Facility Investigation (RFI) Summary Report, Glenn Springs Holdings, Inc., Occidental Chemical Corporation Facility, Wichita, Kansas (CRA 2012d)
- Inorganics Area Supplemental Report, Occidental Chemical Corporation, Wichita, Kansas (CRA 2012g)

Following termination of production and demolition of the Arkema Facility in 2003, a Voluntary Cleanup Investigation (VCI) was undertaken by Arkema under the oversight of KDHE. These activities were summarized in a Comprehensive Voluntary Cleanup Investigation (VCI) Summary Report (ERM 2010). Based on the generated data, the summary report recommended that a focused feasibility study be developed to address impacted media. The VCI was completed in two phases. In addition, there were investigations completed at the Arkema Facility prior to commencement of the VCI activities.

2.2 LAND USE

The land use in the surrounding area is predominantly agricultural interspersed with industrial facilities (generally adjacent to the railroad), undeveloped areas, and some small residential areas.

The adjacent property to the northeast of the Site was formerly operated by Racon/Atofina/Arkema as a fluorocarbon manufacturing plant. The plant operated between 1965 and 2002 and was a major producer of hydrochlorofluorocarbon R-22 and other refrigerants.

DeBruce Grain is located to the northeast of the Site on the east side of the railroad tracks. DeBruce Grain is an agricultural commodities trading company that stores, handles, and sells grain and fertilizer. The DeBruce Grain facility is a very large grain elevator with 246 grain silos and a storage capacity of about 43,000,000 bushels. The shed storage area was subsequently transferred to Builders, Inc. and used as general warehouse space. The remaining silo storage includes approximately 20,700,000 bushels of storage capacity. The DeBruce Grain facility suffered a major explosion on June 8, 1998.

Builders Incorporated owns the Garvey Industrial Park which is located on the east side of the DeBruce Grain facility. The Garvey Industrial Park includes warehousing for general merchandise, lumber, and hazardous materials.

Westar Energy Inc. Murray Gill Energy Center is also located northeast of the Site on the north side of 55th Street. The power plant is a 317-megawatt natural gas and oil fired power plant that began operations in 1954.

The Air Products facility is located southwest of the Facility. Cyclohexylamine was produced at this facility in the 1960s, which was later expanded to produce amine-based intermediates used in pharmaceutical, textile, rubber, plastic, and adhesive manufacturing. An extraction well program to remediate groundwater below the Air Products facility was operated by Abbott Laboratories since 1979. This system was reportedly shut down in 2003.

2.3 CONCEPTUAL SITE MODEL

Stratigraphic data collected during the on-Site groundwater investigation were used to refine the conceptual Site model as discussed in the following sections. Details regarding the collection of the supplemental data identified in this Section are provided in subsequent sections of this report.

2.3.1 OVERVIEW

A detailed discussion of the regional and Site geology and hydrogeology are provided in the report entitled Interceptor Well System Interim Corrective Measures Effectiveness Evaluation (CRA 2010a). A conceptual site model was also provided in that report. To that end, there are four generally discrete sand units, S1 through S4 (oldest to youngest), separated by a sequence of clays and silts, C1 through C4 (oldest to youngest), unconformably deposited and overlying the Wellington Formation. These sequences of alternating layers of sand and clay are representative of alluvial flood plain deposits with the possible exception of the upper parts of the surficial C4 clay layer which were windblown deposits. Previous investigative work had shown that to the east and northeast of the OCC Facility, the clay/silt units separating the sands begin to lose continuity, and the S1 sand unit pinches out where the Wellington bedrock surface rises to within 50 to 60 feet below ground surface (bgs). Moreover, regional geologic information indicates that the S1 sand unit also pinches out approximately 1 mile to the west of the Site. The S1 sand unit is typically encountered between 80 and 105 feet bgs in the vicinity of the Facility. The lowermost sand unit (S1) overlies the shale bedrock and appears to be isolated from the upper sand units by a generally continuous C1 clay/silt layer.

The key components of the 2010 conceptual site model were:

- Stratigraphic and hydraulic monitoring data confirmed that the S2 and S3 aquifer units are in hydraulic connection and are one S2/S3 hydrostratigraphic unit.
- Regional groundwater flow, when the aquifer systems are not stressed through pumping, is believed to be generally to the southeast in both the S1 and S2/S3 aquifers.
- Stratigraphic and hydraulic monitoring data support the conclusion that the S1 sand unit is confined, overlies the shale bedrock, and appears to be isolated from the upper sand units by the continuous C1 clay/silt layer.
- The S1 sand unit pinches out to the east of the Facility where the Wellington bedrock surface rises to within 50 to 60 feet bgs and to the west.

2.3.2 ON-SITE GEOLOGY

Information from the on-Site CPTs[5] identifies that the stratigraphy beneath the Site is variable across the Facility. There appear to be some changes that occur in a north to south direction and the thicknesses of some of the units vary considerably in some cases. The stratigraphic data from the on-Site CPTs, from soil borings completed within the Facility during the RFI, and from the existing monitoring well logs were utilized to generate generalized on-Site geologic cross-sections. The locations of the geologic cross-sections are shown on Figure 3. A north to south trending cross-section is shown on Figure 4 (A-A'), an east to west trending cross-section in the northern portion of the Facility is shown on Figure 5 (B-B'), and an east to west trending cross-section in the central portion of the Facility is shown on Figure 6 (C-C').

The C3 clay layer was encountered in each CPT location, and the thickness of this clay unit ranged from just a few feet thick at CPT-1 and CPT-8 to between 10 and 15 feet thick at the remaining CPT locations. Moreover, the C3 clay layer was encountered in 176 of the 195 soil borings completed during the recent RFI investigations (see Table 1). In the 19 locations where the C3 clay layer was not encountered, six soil borings encountered refusal prior to reaching the target depth and four of the borings were terminated at a depth of 8 feet or less. Observations made during the RFI soil boring program identified that the C3 clay layer was only represented by a sandy clay layer or a few clay seams at a few locations beneath the Facility. As shown on Figures 5 and 6, the

[5] CPT – Cone Penetrometer Testing. Details of this investigation are provided in subsequent sections.

C3 clay layer is approximately a few feet thick in the west side of the Facility and appears to thicken to the east.

The C2 clay layer appears to be present between the S2 and S3 sand layers in the northern portion of the Facility, as show as shown on Figures 4, 5, and 6.[6] Moreover, as shown on Figures 4, 5, and 6, the C2 clay layer is thin or absent to the south. [7]

The C1 clay layer was identified in all nine CPT locations, and the thickness ranged from approximately 8 feet at CPT-9 to nearly 20 feet at CPT-6. The C1 clay layer as shown on Figures 4, 5, and 6 is continuous beneath the Facility.

The S1 sand unit was identified at each of the CPT locations. The S1 sand unit averaged approximately 15 feet in thickness with the exception of CPT-3 where the unit appeared to be only a few feet thick, as shown on Figure 5. The depth to the shale bedrock beneath the Facility ranged from approximately 97 to 105 feet bgs.

2.3.3 OFF-SITE GEOLOGY

The data collected from the off-Site CPT program[8] were used to refine the understanding of the geology beneath the areas surrounding the Site. The CPT data in conjunction with the stratigraphic logs from the monitoring well network were utilized to generate geologic cross-sections of the area surrounding the Site. The locations of the geologic cross-sections are shown on Figure 7, and the geologic cross-sections are shown on Figures 8 (D-D') through 12 (H-H').

Based on an evaluation of the developed cross-sections, the following conclusions can be made regarding the lateral extent of the major stratigraphic units beneath the study area. The C3 clay layer underlies nearly the entire study area. The limits of this unit appear to extend beyond the limits of the study area to the northeast and the southwest. The extent of the C3 clay layer to the northwest appears to extend just to the north and east of CPTs 19 and 23. The C3 layer was not observed at CPTs 13 and 14. The clay layer observed at CPTs 13 and 14 is believed to be more representative of the C2 clay layer. The limit of the C3 clay layer to the southeast is defined by CPTs 31, 37, and 39.

[6] The C2 layer was identified in the logs for CPTs 1, 2, 3, 4 and 9.
[7] The logs for CPTs 5, 6, 7, and 8 do not clearly identify the presence of the C2 clay unit in the southern portion of the Facility.
[8] Details of this investigation are provided in subsequent sections.

The observation of the C2 clay layer beneath the area is sporadic, supporting the previous conclusion that this clay unit is discontinuous beneath the Site and surrounding area. The C2 clay unit was encountered in the northern portion of the main OCC Facility, at CPT-35 and near the MW030 and MW8 monitoring well nests. This unit may also be present to the northwest near CPTs 13, 14, 15, and 16. Based on these observations (and in combination with all other stratigraphic data), the S2 and S3 sand units are considered one continuous sand unit beneath most of the study area.

The S2/S3 sand unit was encountered beneath the entire study area. The additional CPT data demonstrate that the S2/S3 sand layer thickens from approximately 20 feet at the south end of the OCC Facility to approximately 35 feet at IW-44, and then to nearly 60 feet thick near 71st Street. Moreover, the CPT data from CPTs 13, 14, and 23, in conjunction with relevant hydraulic data indicate that the S2/S3 sand unit and the S1 sand unit are likely connected in the northwest portion of the study area near the intersection of 55th Street and Ridge Road (see Figures 8 and 10).

The C1 clay layer underlies nearly the entire study area. The limits of this unit appear to extend beyond the limits of the study area to the north near the MW130 monitoring well nest and to the west of CPT-15. The southern limits of the C1 layer are defined by CPT-36, CPT-30, and MW139S2/S3. The eastern limits are defined by MW136S2/S3 and MW133S2/S3. The extent of the C1 clay layer to the northwest appears to extend just to the north and west of CPT-19. The C1 layer was not observed at CPTs 13, 14, and 23.

The S1 sand unit is laterally extensive across the study area. As shown on Figure 9 (E-E′), the S1 sand unit appears to have a high silt content to the south in some areas based on the CPT data and recent drilling observations. The eastern limits of the S1 sand unit are defined by the MW138 monitoring well nest and CPT 25. The S1 sand unit pinches out approximately ¼-mile west of CPT-38. The eastern limit is defined by where the bedrock surface rises to within 50 to 60 feet of the ground surface. The southern limits of the S1 sand unit are defined by CPTs 30, 32, and 36. The western limit of the S1 sand unit is defined by CPT-16. The CPT data from CPTs 13, 14, and 23 indicate that the S2/S3 sand unit and the S1 sand unit are connected in the northwest portion of the study area. The northern limit of the S1 sand unit appears to extend beyond the MW130 monitoring well nest.

2.3.4 S1 AQUIFER

The S1 aquifer is the basal aquifer overlying the shale bedrock aquitard. The S1 aquifer is separated from the overlying S2/S3 aquifer by the C1 clay layer. The C1 clay layer is present above the S1 aquifer except to the northwest near the intersection of 55th Street and Ridge Road where the S1 and S2/S3 aquifers appear to be one continuous sand unit. The S1 aquifer is a confined aquifer with the possible exception of the area to the northwest of the OCC facility. The limits of the S1 aquifer to the south, east, and west have been defined as noted above. The S1 aquifer tends to thin as it approaches its southern, eastern, and western limits. In addition, the S1 aquifer appears to have a high silt content in some areas.

Regional groundwater flow, when the S1 aquifer system is not hydraulically stressed, is believed to be to the south-southeast.

2.3.5 S2/S3 AQUIFER

The S2/S3 aquifer is the principal aquifer system and generally overlies the C1 clay layer. The S2/S3 aquifer is regionally extensive and underlies the entire study area. In a limited portion of the study area (see previous Section) the S2 and S3 sand units which comprise the S2/S3 aquifer are separated by the C2 clay layer. In general, drilling logs and potentiometric surface data have demonstrated that the S2 and S3 aquifer units are in hydraulic connection and respond in a similar fashion to pumping stresses produced by the interceptor well (IW) system at the Facility, indicating that they generally act as a single hydrostratigraphic unit. The data obtained from CPT-30 and CPT-31 show that the S2/S3 aquifer thickens to approximately 60 feet to the south near 71st Street.

Regional groundwater flow, when the S2/S3 aquifer system is not hydraulically stressed, is believed to be to the south-southeast.

2.3.6 2012 CONCEPTUAL SITE MODEL

In general, data collected from the on-Site groundwater investigation have confirmed the previous (2010) conceptual site model with a few additional refinements as noted below.

The key components of the updated conceptual Site hydrogeologic model are:

- Stratigraphic and hydraulic monitoring data confirm that the S2 and S3 aquifer units are in hydraulic connection and are one S2/S3 hydrostratigraphic unit.[9]
- Regional groundwater flow, when the aquifer systems are not stressed through pumping, is believed to be generally to the south-southeast in both the S1 and S2/S3 aquifers.
- Stratigraphic and hydraulic monitoring data support the conclusion that the S1 sand unit is confined, overlies the shale bedrock, and appears to be isolated from the upper sand units by the continuous C1 clay/silt layer with the exception of an area to the northwest near the intersection of 55th Street and Ridge Road where the S1 and S2/S3 aquifers appear to be one continuous sand unit.
- The S1 sand unit pinches out to the south, east, and west of the Facility. To the east of the Facility, the S1 aquifer pinches out where the Wellington bedrock surface rises to within 50 to 60 feet of the ground surface.
- CPT data show that the S2/S3 aquifer thickens to the south from approximately 20 feet beneath the southern portion of the OCC Facility to approximately 60 feet to the south near 71st Street.

2.4 GROUNDWATER ICM AND MONITORING

The Groundwater ICM for the Site consists of a series of interceptor wells screened in the separate sand aquifers beneath the Site and surrounding areas. The interceptor wells operate to maintain cones of depression within the aquifers to prevent migration of contaminants. The effectiveness of the Groundwater ICM is monitored by measuring analyte concentrations and water levels on a regular periodic basis.

2.4.1 INITIAL GROUNDWATER MONITORING

Observations relating to impacted groundwater at the Facility date back to 1955 when water well number 1 (WW No. 1) was closed due to problems associated with hardness/chloride. Historical plant records indicate that high chlorides and hardness had been found in water wells on the plant site almost from the beginning of operations. Intrusion of saline water ultimately forced the abandonment of Water Wells 1, 2, 3, 4, 5, and 6 as a potable water source and for production supply. During the period from

[9] Information collected during the CPT investigation indicate that the S2 and S3 units are separated by the C2 layer in a limited area located in the northern portion of the Facility, but regionally the two aquifers are considered one hydrostratigraphic unit.

about 1955 to about 1962, several attempts were made to determine the sources of the chlorides and hardness.[10]

Organic compounds in the groundwater beneath the Site were first observed in 1971 when trace organics were found in samples taken from WW No. 6. This well had been used in standby service for several years due to high hardness and chloride levels. The appearance of organics in WW No. 6 prompted the construction of seven on-Site monitoring wells in July 1971. The wells were completed in several different strata in an attempt to determine the source of organic infiltration. These wells, together with the original No. 7 Observation Well, constituted the first comprehensive Site monitoring system. Since this initial groundwater investigation was conducted, numerous phases of groundwater/hydrogeologic investigations have been completed to characterize the groundwater quality beneath the Site and surrounding area.

In late 1976, in response to the detection of inorganic and organic compounds observed in the groundwater, Vulcan initiated a Waste Management Control Program. As part of this program, a Groundwater Management Program was implemented to collect analytical and hydraulic data. Information collected from the program was provided to the Kansas Department of Health and Environment (KDHE). On January 28, 1986, the KDHE issued an administrative order requiring additional groundwater investigation and regular groundwater monitoring and reporting.

2.4.2 CURRENT GROUNDWATER MONITORING NETWORK

Currently, groundwater monitoring and reporting is conducted on a semiannual basis. The current groundwater monitoring well network consists of approximately 140 monitoring wells. The monitoring well locations are shown on Figure 13.

In the fall of 2011, the USEPA approved a regular periodic groundwater monitoring program in which select monitoring wells are sampled on a semiannual, annual, and biennial basis, based on their location with respect to the groundwater contaminant plume. Details regarding the approved program were then documented in the report entitled Sampling and Analysis Plan Routine Groundwater Sampling Plan RCRA Corrective Action Program, Revision 2, dated March 9, 2012 (CRA 2012a).

[10] It is recognized that elevated total dissolved solids (TDS) is characteristic of groundwater in the Wellington Shale.

In addition to the monitoring well sampling program, OCC conducts regular monitoring of production wells and water supply wells located on neighboring properties. The program includes sampling at neighboring industrial facilities and nearby residential/agricultural properties. A portion of this monitoring program is required under the Facility's current RCRA Permit, and a portion of the sampling program is completed on a voluntary basis.

2.4.3 CURRENT INTERCEPTOR WELL OPERATIONS

The current groundwater ICM consists of 12 interceptor wells. Ten of these wells extract groundwater from the S2/S3 aquifer (IW30, 31, 32, 35A, 35B, 40, 41, 42, 43, and 44) and two interceptor wells extract groundwater from the S1 (deep) aquifer (IW-29 and IW-36). The locations of the interceptor wells are shown on Figure 13.

3.0 SUMMARY OF FIELD ACTIVITIES AND TASKS COMPLETED

3.1 INVESTIGATIVE OBJECTIVES

The primary objectives of the on-Site groundwater investigation were to:

- Identify and delineate areas where DNAPL has previously been identified.
- Further define the subsurface geology beneath the main facility area of the Site.
- Further define the groundwater quality beneath the main facility area of the Site.
- Further define the subsurface geology in the areas surrounding the Site.

In order to meet the Phase I objectives, the following four tasks were completed:

- Completion of 55 focused soil borings within the main facility area to identify and delineate potential source areas beneath the Site where DNAPL has previously been identified.
- Completion of nine on-Site cone penetrometer test (CPT) soundings within the main facility area to better define the subsurface geology beneath the Site.
- Completion of an on-Site groundwater screening program within the main facility area based on the focused soil boring and CPT findings to define the groundwater quality beneath the Site.
- Completion of 30 off-Site CPT soundings to better define the subsurface geology in areas surrounding the Site.

In addition to the scope of work outlined in the Work Plan, a Geoprobe groundwater screening program was completed to the east and southeast of the OCC Facility. Phase III landfill investigation data are also provided herein. Details regarding these investigations are discussed in the following sections.

3.2 FOCUSED SOIL BORING INVESTIGATION

The objective of the focused soil boring investigation was to further investigate the nature and extent of DNAPL that has previously been identified in several on-Site monitoring wells within the Facility and on an adjacent (i.e., Arkema) property. The presence of DNAPL beneath the Facility represents a potential source of contamination in groundwater. Soil borings were advanced using direct push technology (DPT) to the top of the C3 clay layer, which is the first low permeability zone where any accumulated

DNAPL is expected to possibly pool. On this basis, the focus of this investigation was the collection of deep soil samples collected at or near the interface between the S4 sand unit and the underlying C3 clay layer. Table 1 provides a summary of the depths at which the C3 clay unit was encountered at the 195 soil borings completed during the RFI within the Facility boundary (includes 2012 borings). DPT drilling activities associated with the focused soil boring investigation were combined with many of the soil borings completed as part of the Chloromethanes I, II, Perc, and Hazwaste Areas and the Arkema Area RFI. A summary of the results from the above-noted investigations were presented in a report entitled Chloromethanes I, II, Perc and Hazwaste Areas RCRA Facility Investigation and Arkema Area Investigation Summary Report, dated August 2012 (CRA, August 2012). Much of the soil sampling data discussed in this report includes data presented in the referenced August 2012 summary report. Additionally, information collected from the other 143 RFI soil borings completed within the Facility are utilized in the evaluation process.

The scope of work for the focused soil boring portion of the investigation consisted of the following:

- Nine soil borings advanced to the top of the C3 clay layer within the Chloromethanes I, II, and Perc Area, including locations near/surrounding monitoring well nests MW18 and MW27.
- 15 soil borings advanced to the top of the C3 clay layer at locations surrounding the perimeter of the Arkema property.
- 28 soil borings advanced to the top of the C3 clay layer within the Hazardous Waste Storage AOC and in the vicinity of the former hex pits.
- Three soil borings advanced to the top of the C3 clay layer near monitoring wells MW113S3 and MW114S1.

The final number of soil borings completed exceeded the number originally proposed by the Work Plan. These extra soil borings were added due to observations of potential contamination made during the advancement of soil borings completed in conjunction with the RFI investigations that were conducted concurrently with the on-Site groundwater investigation. The Phase I soil boring locations associated with the on-Site groundwater investigation are illustrated on Figure 14 along with the other RFI soil borings completed within the Facility.

Soil boring procedures were conducted in accordance with the procedures outlined in the Sampling and Analysis Plan (SAP) (CRA 2009a) and followed during other RFI investigations. Soil boring locations were finalized in the field based on field conditions and physical constraints of plant features. Specifically, certain areas occurred (adjacent to SWMUs) where borings could not be advanced due to the presence of underground utilities, process equipment, overhead equipment, or other physical constraints. The borehole at each DPT location was pre-cleared to a depth of approximately 5 feet below grade using vacuum excavation equipment.

All of the boring locations were established by use of both a GPS unit and through field measurements. Copies of the focused soil boring logs are provided in Appendix A. Headspace photoionization detector (PID)/flame ionization detector (FID) readings and dye test results are included on these logs.

Soil borings were continuously sampled to the top of the C3 clay stratigraphic unit using DPT drilling methods. A trained geologist logged and described the soils using the Unified Soil Classification System (USCS). The collected soil samples were screened at 2-foot intervals with a PID or near the Arkema area using an FID, using headspace monitoring techniques. During borehole advancement, if PID/FID headspace monitoring or olfactory evidence indicated signs of significant impacts and/or the possible presence of DNAPL or light non-aqueous phase liquid (LNAPL), a representative sample of this interval was dye tested in the field using Oil Red O hydrophobic dye to confirm the potential presence of NAPL. Appendix B contains field procedures used for conducting the dye testing using Oil Red O.

In accordance with the approved Work Plan, at each soil boring, one soil sample was retained for chemical analyses from the interval at or just above the C3 clay layer (the interval within 3 feet of the top of the clay layer). At a few locations, additional samples were collected from above this interval based on PID screening or dye test results. However, the primary focus of the soil samples collected as part of the on-Site groundwater investigation was the deep samples collected at or near the interface between the S4 sand unit and the C3 clay unit. Since perched groundwater was not encountered in soil borings advanced near monitoring wells MW113S3 and MW114S1, soil samples were also collected in this area just above the C3 clay layer.

Collected soil samples were analyzed for the Site Contaminants of Concern (COC) list and for several additional parameters. The COC list and additional parameters for soil samples collected from the Chloromethanes I, II, Perc and Hazwaste Areas; the Arkema Area; and the area near monitoring well MW113S3 are provided in Tables 2, 3, and 4, respectively. Test methods and additional details regarding sampling and analysis are provided in the Quality Assurance Project Plan (CRA 2009d).

During the investigation, nine soil samples were collected from apparently unimpacted zones for total organic carbon (TOC) analyses. These samples were collected from several different areas within the main plant area, thereby providing area-wide coverage. TOC samples were collected from various sample intervals where PID readings and olfactory evidence did not indicate signs of contamination. The collected TOC data were utilized to develop a background TOC level for the Site.

PID readings, olfactory evidence, dye test results, and chemical analyses were utilized to identify areas where NAPL may be present. The chemical analyses were used to characterize any observed potential NAPL. These data were then compared to the soil TOC data and soil saturation limits of the observed compounds.

3.3 ON-SITE CONE PENETROMETER TESTING

Prior to the successful implementation of the investigation reported herein, stratigraphic information beneath the main portion of the Facility and the surrounding area was somewhat limited and largely based on older soil boring/monitoring well logs containing limited and incomplete information. To better define the stratigraphy in this area, an on-Site CPT investigation within the plant boundary was completed. Nine CPT soundings (CPT-1 through CPT-9) were advanced to bedrock or to refusal. Upon completion, the CPT holes were sealed with a bentonite grout using a tremie rod. Due to the possible presence of underground utilities, the borehole at each DPT location was pre-cleared to a depth of approximately 5 feet below grade using vacuum excavation equipment. Fugro Consultants Inc. of Houston Texas was retained to provide CPT services. The locations of the completed on-Site CPT soundings are illustrated on Figure 15.

In accordance with the approved Work Plan, prior to beginning the CPT program, a test sounding was performed adjacent to monitoring well MW140S1 to compare the CPT stratigraphic information to that observed during the installation of MW140S1. Figure 16 provides a comparison of the CPT-140 CPT log against the stratigraphic information collected during the installation of monitoring well MW140S1. As shown on Figure 16, there is an excellent correlation between the CPT log and the rotary sonic drilling log from MW140S1. Based on this correlation, CPT appeared to provide accurate stratigraphic information.

CPT soundings are completed by hydraulically advancing a pressure-sensitive electronic piezocone penetrometer attached to a string of approximately 2-inch diameter rods into the ground with an approximately 20- to 30-ton truck to provide stability and counterweight. Measurements of tip resistance, sleeve resistance (i.e., local friction), and dynamic pore water pressure are recorded at 1- to 5-centimeter intervals as the piezocone is advanced into the soil. These data, along with the calculated friction ratio between tip resistance and sleeve resistance, are then used to elucidate the subsurface stratigraphy.

In conjunction with the CPT sounding, an electrical conductivity (EC) sensor/detector was deployed to measure and log soil electrical conductivity. The DNAPL at the Site appears to be a non-conductive organic liquid.[11] Therefore, the EC detector was used to aid with the identification of DNAPL within the subsurface. The collected EC data, however, did not identify any potential DNAPL. It should be noted, however, that the on-Site CPT soundings were located in areas where DNAPL was not expected to be encountered in order to avoid potential vertical migration during CPT advancement.

One major advantage of CPT over soil borings completed with other techniques is that a large amount of stratigraphic data can be collected rapidly and without generating a large volume of soil cuttings. During the CPT investigation, daily total CPT production rates ranged from between 350 to over 500 feet per day.

Copies of the CPT logs and CPT measurement data are provided in Appendix C.

3.4 ON-SITE GROUNDWATER SCREENING PROGRAM

The objective of the groundwater screening program was to further define groundwater quality both horizontally and vertically within the main Facility area. The stratigraphic data generated during the on-Site CPT investigation were evaluated in conjunction with the soil boring data to identify intervals where groundwater screening samples would be collected. These data were evaluated to select groundwater screening intervals to supplement existing data from the on-Site monitoring well network. Prior to implementing the sampling, a table summarizing 22 proposed groundwater screening intervals was provided to the USEPA on May 3, 2012. A copy of this table as provided to USEPA is presented as Table 5.

Groundwater screening samples were collected using the CPT rig and specialized rods configured with a screened end that could be advanced to a specific interval and then

[11] This determination was based on past experience measuring DNAPL thickness with an electronic interface probe and on DNAPL sample characterization.

retracted, thereby exposing the screen to facilitate the collection of the groundwater sample.

3.5 OFF-SITE CONE PENETROMETER TESTING

The detailed interpretation of the subsurface stratigraphy beneath the Site and the surrounding area is complicated by the age of some of the stratigraphic logs, logs with random sampling intervals, and logs with limited descriptive information. Furthermore, the stratigraphic records stretch over a 30-year period and were created by numerous different entities. In some instances, the stratigraphic units do not appear to correlate with the surrounding stratigraphic interpretations. Due to this data gap, an off-Site CPT program was completed to obtain additional stratigraphic information to refine the conceptual geologic model of the area. Several of the off-Site CPT locations were advanced near existing monitoring wells to confirm the stratigraphy at these locations. (This additional stratigraphic information will aid in further evaluating the actual well screen classification in many of the older monitoring wells and interceptor wells.)

The off-Site CPT program consisted of the advancement of 30 CPTs (including the MW140S1 test CPT location). Figure 17 illustrates the locations of the off-Site CPTs. The majority of these CPTs were installed on the roadways surrounding the Facility. A right-of way permit was obtained from Sedgwick County prior to performing the work. Each of these CPTs was advanced to refusal, which was assumed to correspond to the top of the underlying bedrock. The total depth reached by the off-Site CPTs ranged from 55.2 feet bgs at CPT-39 (eastern part of test area where the bedrock rises closer toward the surface) to 131.1 feet bgs at CPT-33 (southwestern portion of test area). Copies of the CPT logs and CPT measurement data are provided in Appendix C.

In conjunction with the CPT sounding, an EC sensor/detector was deployed to measure and log soil electrical conductivity.

3.6 PHASE III LANDFILL INVESTIGATION

The Phase III Landfill Area Investigation was completed on January 11 and 12, 2012 at the Area of Concern referred to as the Chemical Waste Landfill (Landfill). The Phase III scope of work (SOW) was outlined in Section 5 of the RFI Summary Report Alpha Cake Landfill, Hex Waste Pits and Brine Ponds report dated January 2011 (CRA 2011a). The objective of the investigation was to further delineate the areal contaminant boundaries further to the south and east of the Landfill.

Appendix D contains a letter report summarizing the work completed as part of this supplemental investigation and the resulting data collected.

3.7 GEOPROBE GROUNDWATER SCREENING PROGRAM

A Geoprobe groundwater screening program was completed during the period from September 11 through September 14, 2012 on land parcels generally located to the east and southeast of the Facility. The two objectives for the groundwater screening program were as follows:

- obtain groundwater chemistry data from areas to the south and east of the intersection of 63rd Street and Hoover Road to evaluate the installation of a potential supplemental S2/S3 interceptor well in this area; and
- obtain groundwater chemistry data from areas upgradient of potential supplemental S2/S3 interceptor well locations.

Appendix E contains a letter report summarizing the work completed as part of this supplemental investigation and the resulting data collected.

4.0 SUMMARY OF RESULTS

4.1 ON-SITE GROUNDWATER INVESTIGATION

The following section presents and evaluates the data collected in accordance with the approved Work Plan during Phase I of the on-Site groundwater investigation. Further details are provided by the following discussion.

4.2 FOCUSED SOIL BORING PROGRAM OBSERVATIONS

4.2.1 OBSERVATIONS

The Phase I focused soil boring locations are illustrated on Figure 14. The stratigraphic boring logs, which provide the observations made during the investigation, including PID (or FID) readings, are provided in Appendix A.

In general, during the soil boring program, observed subsurface geologic conditions consisted of i) a top few feet of fill material[12] followed by ii) a clay layer, followed by iii) sand to a depth of 27 to 39 feet, followed by iv) clay, which was typically observed between 27 and 39 feet below grade.

Deep[13] soil samples were collected from nine soil borings (CM-3, CM-5, CM-7, CM-18, CM-22, CM-31, CM-33, CM-36, and CM-37) within the Chloromethanes I, II, and Perc Area. Deep soil samples were collected at these locations to provide area–wide coverage of this portion of the Facility. Soil borings CM-3, CM-5, and CM-7 were completed in the area surrounding the MW27 monitoring well nest due to the previous detection of DNAPL in MW27S2 and MW27S1. Staining, odors, or elevated PID readings were not observed or detected at these three soil borings with the exception of a 95 units[14] headspace reading at the bottom of the CM-7 borehole.

Soil borings CM-18, CM-36, and CM-37 were advanced in the area surrounding the MW18 monitoring well nest due to the previous detection of DNAPL in some of these wells. Staining, odors, and only low to moderate PID readings (ranging from 2.1 to 43.6 units) were observed at these three soil borings.

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[12] However, because the majority of borings were "air knifed", observations for the first 5 feet of soils were limited.

[13] Deep soil samples referred to in this section correspond to a soil sampling interval at the interface of the S4 sand unit with the C3 clay layer. As discussed previously, this was the first interval where the potential for NAPL accumulation was suspected.

[14] Units – meter deflection units as the PID's sensitivity is non-specific.

Deep soil samples were collected from 28 soil borings (CM-39, CM-40, and CM-42 through CM-67) within the Hazwaste Area. Soil boring CM-41 encountered refusal at depths of 16 and 18 feet bgs on two attempts to complete this borehole. Deep soil samples were collected at the locations to provide area–wide coverage of this portion of the Facility and to investigate the former hex waste pit that was located in this portion of the Facility. Staining, odors, elevated PID readings, and a positive dye test result were observed at several of the soil borings completed within the Hazwaste Area. Soil boring CM-64 was installed near the MW19 monitoring well nest due to the previous detection of DNAPL at this nested location. Odors, elevated PID readings, and a positive dye test were observed at the base of this soil boring.

Deep soil samples were collected from all 15 soil borings (AR-1 through AR-15) completed around the perimeter of the Arkema property. Deeper soil samples were collected at these locations to provide area–wide coverage around the perimeter of this portion of the Facility and due to the reported observation of DNAPL in soil borings completed by Arkema. DNAPL was reportedly encountered in the southwest corner of the adjacent Arkema property during investigations associated with a State-led Voluntary Cleanup Program investigation conducted by Arkema. Documentation of the identification of DNAPL is provided in a report entitled Voluntary Cleanup Investigation Report Arkema, Inc. Wichita, Kansas Plant, dated February 25, 2005, and prepared by ERM (ERM 2005). During the investigation, which was initiated in early 2004, DNAPL was reportedly encountered in two soil borings (PA/SB023 and PA/VC02).

Odors, elevated FID readings, and positive dye tests were only observed in two soil borings (AR-1 and AR-2) completed at the southwestern corner of the Arkema property. Staining, odors, and elevated FID readings were not observed in the remaining soil borings advanced around the perimeter of this property.

Deep soil samples were collected from three soil borings (IA-100, IA-101, and IA102) advanced to the top of the C3 clay layer near monitoring wells MW113S3 and MW114S1. The USEPA requested that soil borings be advanced near monitoring well MW113S3 in order to assess this area for the potential presence of NAPL due to the observance of several COCs detected in the groundwater at MW113S3. Staining, odors, and elevated PID readings were not observed in the three soil borings advanced around monitoring well MW113S3.

4.2.2 DYE TEST RESULTS

If PID/FID monitoring or olfactory evidence indicated the possible presence of NAPL, a representative sample of this interval was field dye tested using Oil Red O hydrophobic dye to test for the possible presence of NAPL. Dye testing results are noted on the stratigraphic logs (see Appendix A) and are summarized in Table 6. Positive dye tests were observed at 14 locations (AR-1, AR-2, CM-22, CM-33, CM-47, CW-48, CM-49, CM-50, CM-51, CM-55, CM-57, CM-63, CM-64, and CM-65). Figure 18 illustrates the locations of the soil borings where positive dye tests occurred. A positive dye test indicated the potential presence of NAPL in the subsurface.

Other observed indicators of the possible presence of NAPL included a sheen observed on the soils in soil borings CM-33 (at 39.8 feet), CM-55 (at 33.4 feet), and CM-63 (at 33.9 feet). Additionally, visible pooled DNAPL was observed at soil boring CM-51 at a depth of 35 feet bgs[15].

4.2.3 SOIL ANALYTICAL RESULTS

Analytical results for the deep soil samples collected in the Chroromethanes I, II, Perc and Hazwaste Areas are summarized in Table 7, from the Arkema Area in Table 8, and near monitoring well MW113S3 in Table 9. The compounds that were detected with the greatest frequency and at the highest concentrations were generally carbon tetrachloride, chloroform, hexachlorobenzene, hexachlorobutadiene, hexachloroethane, and tetrachloroethylene. Tables 7, 8, and 9 summarize the results detected above the USEPA's industrial soil Regional Screening Levels (RSLs)[16]. Tables 7, 8 and 9 also summarize the results from the soil samples collected from apparently unimpacted zones for TOC analyses (see CRA, August 2012c for remaining TOC results). Table 10 provides a summary of the soil TOC samples collected as part of this investigation. The collected TOC data were utilized to develop a representative background TOC level for the Site. To that end, TOC concentrations from the four samples collected in the upper S4 sand unit were all below the laboratory detection limits that ranged from 1,000 to 1,200 milligrams per kilogram (mg/kg). These data indicate that the S4 sand has a low TOC concentration, demonstrating that the sand would likely have a limited ability to retard vertical DNAPL migration. The TOC concentrations from the five soil samples collected from the C3 clay layer ranged from 2,200 to 2,700 mg/kg, with a calculated average concentration of 2,440 mg/kg. The average TOC concentration of the C3 clay

[15] It is noted that at all locations in which "other observed indicators of the possible presence of NAPL" were found also had corresponding positive dye test results.
[16] USEPA Region 9 Regional Screening Levels Summary Tables, updated May 2012.

layer is significantly higher than that of the sand layer, and this characteristic along with an assumed lower hydraulic conductivity for the C3 clay layer indicates that any potential DNAPL should tend to pool or be retained by this clay layer. Additionally, if the sum of organic compounds in the deeper soil samples exceeds the average TOC concentration of 2,440 mg/kg, these data suggest the potential for DNAPL accumulation. To that end, the sum of organic compounds in the deeper soil samples exceeded the background TOC value of 2,440 mg/kg at CM-22 (37.5-40.5 feet bgs), CM-48 (30-32 feet bgs), CM-55 (32.5-34 feet bgs), and CM-64 (30-32 feet bgs). All of these locations had samples exhibiting a positive dye test result.

Several soil samples had concentrations exceeding the soil saturation limit as summarized in Tables 7, 8, and 9. These included the following compounds and boring locations (soil sample collection depths are in parenthesis):

- CM-22 (37-40.5 feet bgs) – carbon tetrachloride and perchloroethylene
- CM-33 (39-41 feet bgs) - carbon tetrachloride and perchloroethylene
- CM-43 (5-7 feet bgs) – perchloroethylene
- CM-47 (30-32 feet bgs) – perchloroethylene
- CM-48 (30-32 feet bgs) – hexachlorobutadiene
- CM-55 (32.5-34 feet bgs) - hexachlorobutadiene
- CM-57 (30-33 feet bgs) – perchloroethylene
- CM-64 (10-15 feet bgs) – perchloroethylene
- CM-64 (30-32 feet bgs) – carbon tetrachloride and perchloroethylene
- AR-1 (30-32 feet bgs) - perchloroethylene

Final analytical data reports are provided (in CD format) as Appendix F. The data validation memoranda are provided (in CD format) as Appendix G.

4.2.4 NAPL DELINEATION

The indicators utilized to evaluate the potential presence of NAPL during Phase I were the following:

- samples exhibiting a positive dye test result;
- samples exhibiting a total organics concentration greater than the measured average C3 clay unit TOC concentration of 2,440 mg/kg;

- samples exhibiting specific analyte concentrations in excess of the specific soil saturation limit for that compound;
- groundwater analyte concentrations above the aqueous solubility results; and
- visual observations of NAPL impact.

Table 11 provides a comparison of the collected soil analytical results and observations from the Phase I focused soil boring program to the four NAPL indicators listed above. Based on this comparison there are 15 locations (CM-22, CM-33, CM-43, CM-47, CM-48, CM-49, CM-50, CM-51, CM-55, CM-57, CM-63, CM-64, CM-65, AR-1, and AR-2) in which the collected Phase I data indicated the potential presence of NAPL at the S4 sand unit and C3 clay unit interface. Two of these locations, CM-22 and CM-33, are located in the southern portion of the Chloromethanes I, II, and Perc Area and the remaining 12 locations are located in the western half of the Hazwaste Area.

Based on a review of the RFI soil boring program, the NAPL encountered at the Site appears likely to originate from older historic sources and facility practices prior to the implementation of the Site-Wide Waste Management Program implemented by the Facility in 1977. This conclusion is supported by the lack of NAPL observations within the S4 sand above the C3 clay. Moreover, the NAPL observations and positive dye tests were within the C3 layer, indicative of older sources that have had time to infuse into the lower permeable clay. Most significantly, the lack of pooled NAPL situated above the C3 layer suggests that a continuing source of NAPL in no longer present at the Facility.

4.3 ON-SITE CONE PENETROMETER TESTING

Nine CPT soundings (CPT-1 through CPT-9) were advanced to bedrock or to refusal. The locations of the completed on-Site CPT soundings are illustrated on Figure 15. The total depth reached by the on-Site CPTs ranged from 98.7 feet bgs at CPT-8 to 108.7 feet bgs at CPT-7. These depths are consistent with the expected depth to bedrock. Copies of the CPT logs and CPT measurement data are provided in Appendix C.

The CPT logs identify that the stratigraphy beneath the Site is not consistent across the entire Facility. There appear to be some changes that occur in a north to south direction, and the thickness of some of the units varies. The additional stratigraphic data obtained from the on-Site CPT program and how these data have refined the conceptual site model is discussed in Section 2.0 and again later within this Section.

4.4 ON-SITE GROUNDWATER SCREENING PROGRAM OBSERVATIONS

4.4.1 OVERVIEW

The objective of the groundwater screening program was to further define groundwater quality both horizontally and vertically within the main Facility area. Table 12 provides a summary of the groundwater samples collected and the requested analytical parameters. Of the 22 proposed samples, only 19 could be collected. Three of the proposed intervals did not produce water, either because the CPT screen did not open correctly, the screen became clogged, or the formation simply did not produce water. No samples were collected from these three intervals. In addition, at seven of the proposed sample intervals the formation/sampling equipment did not produce a sufficient volume of water to fill enough sample containers to permit analysis of the full COC list of parameters.

4.4.2 CPT GROUNDWATER ANALYTICAL RESULTS

Table 13 provides a summary of the analytical results from the CPT groundwater screening program, with the specific detections that exceeded the Maximum Contaminant Level (MCL)[17] or RSL highlighted. Copies of the original laboratory analytical reports are provided (in CD format) as Appendix F. Continental Analytical Services (CAS) performed the analyses of the groundwater samples. The analytical data validation report is provided (in CD format) as Appendix G.

All of the COCs, with the exception of chloromethane and 2,5-dichlorophenol, were detected during this groundwater screening program. In general, the samples collected from the upper portion of the S2/S3 aquifer had higher concentrations than the samples collected from the lower portion of the aquifer. The groundwater screening samples collected from CPT-9, located in the central portion of the Facility, had the highest detections of COCs.

4.5 OFF-SITE CONE PENETROMETER TESTING OBSERVATIONS

The off-Site CPT program consisted of the advancement of 30 CPTs (including the MW140S1 test CPT). Figure 17 illustrates the locations of the off-Site CPTs. Each of

[17] In the case of chloroform and chloride, reported concentrations were compared to the Maximum Contaminant Level Goal (MCLG) and secondary MCL, respectively.

these CPTs was advanced to refusal, which was assumed to correspond to the top of the underlying bedrock. The total depth reached by the off-Site CPTs ranged from 55.2 feet bgs at CPT-39 (eastern part of test area) to 131.1 feet bgs at CPT-33 (southwestern portion of test area)[18]. Copies of the CPT logs and CPT measurement data are provided in Appendix C.

The additional stratigraphic data obtained from the off-Site CPT program and how these data have refined the conceptual Site model are discussed in Section 2.0. Appendix H provides a generalized comparison of the collected CPT data to the logged stratigraphy of several nearby existing monitoring wells. In general, this comparison does identify several inconsistencies in the logged monitoring well stratigraphy to that of the interpreted CPT data. However, the comparison did not identify any monitoring wells where the referenced sand unit needed to be reclassified.

4.6 INTERIM GROUNDWATER ICM RE-EVALUATION

This section presents an interim re-evaluation of the effectiveness of the interceptor well network which was installed as an ICM for containing and capturing impacted groundwater at the Facility. A detailed evaluation of the groundwater ICM was provided in the report entitled Interceptor Well System Interim Corrective Measures Effectiveness Evaluation (CRA 2010a) (ICM Effectiveness Evaluation). The evaluation process presented in this referenced report followed the USEPA's recently published guidance document entitled *A Systematic Approach for Evaluation of Capture Zones at Pump and Treat Systems*, dated January 2008 (USEPA 2008).

A key component of the ICM evaluation process is that the evaluation process is an ongoing continuous process that requires re-evaluation as new information is developed that may affect the ICM. To that end, a significant amount of additional information has been obtained from the On-Site Groundwater Investigation, the recent RFI soil boring program, the evaluation of potential contaminant sources, an evaluation of the 2012 Geoprobe Groundwater Screening Investigation, and an evaluation of the groundwater quality data from the last several regular groundwater monitoring events that have occurred since the ICM Effectiveness Evaluation was undertaken. The intent of this interim re-evaluation is to highlight this recent stratigraphic, chemical trend and potential contaminant source information to aid in the ongoing analysis of the effectiveness of the groundwater ICM and validate the conclusions from the 2008 evaluation. In order to ensure the effectiveness of the groundwater ICM, this additional

[18] CPT may have penetrated into a highly weathered portion of the underlying shale.

information is being summarized to determine the overall effectiveness of the ICM, identify data gaps, and identify potential ICM modifications or enhancements.

4.6.1 S1 AQUIFER

Currently, OCC operates two interceptor wells, IW29 and IW36, to extract groundwater from the deep aquifer (S1). The S1 aquifer is a confined unit and these two interceptor wells are screened over 80 percent of the thickness of the aquifer. Groundwater contours generated from regular water level monitoring events collected from nearby monitoring wells and piezometers have consistently demonstrated a strong radial flow inward towards these two interceptor wells. Figure 19 illustrates the S1 aquifer groundwater contours generated from the hydraulic monitoring event completed in August 2012. This figure illustrates a strong radial flow inward towards these two interceptor wells.

Trends of the groundwater analytical results from the samples collected from the monitoring wells screened in the S1 aquifer indicate that the COCs have generally remained stable over the past 2 years. These groundwater quality trend data confirm that the S1 aquifer groundwater ICM is currently effective.

Additional stratigraphic information obtained during the on-Site groundwater investigation has defined the horizontal extent of the S1 aquifer to the east, west, and south.[19] Based on these additional stratigraphic data, the S1 hydraulic monitoring data, and the groundwater chemistry data the capture zone induced from the two S1 interceptor wells is sufficient and the groundwater ICM is currently effective.

These data indicate that the S1 aquifer groundwater ICM is highly effective.

4.6.2 S2/S3 AQUIFER

The S2/S3 aquifer extraction system is comprised of ten interceptor wells: IW30, IW31, IW32, IW35A, IW35B, IW40, IW41, IW42, IW43, and IW44. The S2/S3 aquifer is generally an unconfined aquifer and the interceptor wells are generally screened over the lower half of the aquifer's thickness. IW41 and IW42 are distant wells located over a mile away from the OCC facility. These interceptor wells were installed to address the presence of BHC in S2/S3-screened monitoring wells distant from the Facility. The

[19] The additional stratigraphic CPT data has shown that the S1 aquifer thins and pinches out to the east, west, and south, defining the limited horizontal extent of the aquifer in these directions.

remaining eight IWs are located at the south end of the OCC facility, the south side of the landfill, or within the Nature Center Area. IW43 and IW44 were installed in 2010 in response to a data gap investigation completed as part of the 2010 ICM effectiveness evaluation recommendations.

Groundwater contours generated from water level data collected from nearby monitoring wells generally illustrate an inward radial flow towards these interceptor wells. Figure 20 illustrates the S2/S3 aquifer groundwater contours generated from the hydraulic monitoring event completed in August 2012. These hydraulic data indicate that the S2/S3 aquifer groundwater ICM is largely effective. However, significant off-Site pumping influences by industrial and agricultural users is believed to affect the efficacy of this system.

Trends of the groundwater analytical results from the samples collected from the monitoring wells screened in the S2/S3 aquifer indicate that some COC concentrations are increasing. Specifically, the concentrations of carbon tetrachloride in several S2/S3 monitoring wells located to the east of Hoover Road have been slowly increasing or, in the case of MW138 S2/S3, are now being observed at concentrations above the laboratory detection limit. These groundwater quality trend data in conjunction with hydraulic data indicate that enhancements to the S2/S3 aquifer groundwater ICM may be required by way of supplemental pumping.

Additional stratigraphic information obtained during the off-Site CPT program demonstrate that the S2/S3 aquifer thickens to the south from approximately 20 feet beneath the OCC Facility to approximately 60 feet thick near 71st street.

5.0 GROUNDWATER CONTAMINANT SOURCE EVALUATION

An evaluation of potential sources of groundwater contamination was performed using historical soil and groundwater data, data from the current groundwater monitoring network, and data collected during the implementation of the work described in the 2012 "On-Site Groundwater Investigation RCRA Facility Investigation (RFI) Work Plan" (CRA 2012b). Information from the January 2012 Phase III Landfill Investigation, and RFI work plans and reports for individual AOCs was also included in this evaluation, along with the results of the 2012 Geoprobe groundwater screening investigation.

5.1 DELINEATION OF DNAPL AREAS

One of the goals of the on-Site groundwater investigation was to identify and delineate areas where DNAPL had previously been identified. The potential for the occurrence of DNAPL was assessed using NAPL dye testing, a comparison of chemical concentrations to soil saturation limits, a comparison of the total organic compound concentrations (e.g., VOCs plus SVOCs) of individual soil samples to the attenuation capacity of native soil (2,440 mg/kg)[20], a comparison of groundwater results to the aqueous solubility limit, and the direct observation of DNAPL in wells or borings. Based on these observations, ten areas at or adjacent to the Facility were identified with the potential for DNAPL or free phase solids to exist. Each identified area was also classified by the primary chemical constituents of the potential DNAPL. These areas are shown on Figure 21.

The extent of potential DNAPL in the deeper S2 and basal S1 aquifers will be the subject of additional investigation. Further details on observed DNAPL and "high concentration" soil results are provided by the following sections.

5.2 INITIAL SCREENING OF ANALYTICAL RESULTS

Analytes and analyte groups were selected for evaluation based on their identification in groundwater or soil samples collected during the various RFIs performed at the Site in 2010-2012 and a review of historical information. Soil analytical results were compared against the generic soil saturation limits (Csat) published in the USEPA RSL tables (USEPA 2012) or alternately the Kansas RSK guidance tables (KDHE 2010). Groundwater analytical results were compared to their aqueous solubility. The analytes and analyte groups selected for evaluation are presented below:

[20] Based on the average TOC concentration from non-impacted C3 clay soil as discussed in Section 3.2.

Perchloroethylene (PCE) and Related Compounds	Pentachlorophenol and Related Compounds
Perchloroethylene*†‡ Trichloroethene Vinyl chloride Hexachlorobenzene*†‡ Hexachlorobutadiene*†‡♦ Hexachloroethane*† 1,1,1-Trichloroethane 1,2-Dichloroethane	Pentachlorophenol*†‡ 2,3,4,6-Tetrachlorophenol† 2,4,6-Trichlorophenol† 2,4-Dichlorophenol 2-Chlorophenol
Chloromethanes	**Benzene Hexachloride (BHC) and Related Compounds**
Carbon tetrachloride*†‡♦ Chloroform (Trichloromethane) †‡♦ Methylene chloride† Chloromethane†	alpha-BHC♦ beta-BHC ♦ gamma-BHC (Lindane)*†♦ Benzene Toluene
Other Compounds	
2,4-Dichlorophenoxyacetic acid (2,4-D) † 1,2-Dichloropropane† Trichlorofluoromethane (CFC-11) †	
*analyte detected in soil at concentrations exceeding default Csat values. †analyte detected in groundwater at concentrations exceeding 1% of the aqueous solubility. ‡analyte detected in groundwater at concentrations exceeding 10% of the aqueous solubility. ♦analyte detected in groundwater above the MCL/RSL objective at a distance greater than half a mile from the facility.	

Table 5.1 Analytes selected for an evaluation of the potential for significant impacts to groundwater.

Several compounds including 2,4-D, 2,4-dichlorophenol, gamma-BHC, hexachlorobenzene, hexachlorobutadiene, pentachlorophenol, 2,3,4,6-tetrachlorophenol, and 2,4,6-trichlorophenol do not have soil saturation limits identified in the USEPA RSL tables (because they are solids at ambient temperatures). For these compounds, the soil saturation limits provided in the Risk-Based Standards for Kansas (RSK) table were used. These compounds will not exist as a DNAPL under ambient conditions unless present with other chemicals that induce a co-solvency effect.

The source evaluation for each analyte or analyte group is described in the following sections.[21]

5.2.1 PERCHLOROETHYLENE (PCE) AND RELATED COMPOUNDS

Perchloroethylene is a chlorinated solvent commonly used in dry cleaning and is a colorless liquid at ambient temperatures. Related compounds include the production byproducts hexachlorobenzene, hexachlorobutadiene, and hexachloroethane and degradation products trichloroethene, 1,1,1-trichloroethane, 1,2-dichloroethane, and vinyl chloride.

5.2.1.1 OPERATIONAL HISTORY

Perchloroethylene was produced by the chlorination of light hydrocarbons (from natural gas) to form hexachloroethane followed by thermal decomposition to form perchloroethylene.

$C_2H_6 + 6Cl_2 \rightarrow 6HCl + C_2Cl_6$ (hexachloroethane)
$C_2Cl_6 + \rightarrow Cl_2 + C_2Cl_4$ (perchloroethylene)

Reaction byproducts can include chlorine gas, hydrochloric acid, carbon tetrachloride, hexachlorobutadiene, hexachloroethane, and hexachlorobenzene.

The facility's perchloroethylene production plant (Perc Plant) began producing perchloroethylene in 1958 and ceased operation in 1996. After the closure of the Perc Plant, perchloroethylene was only handled or stored in the R&D Pilot Plant (Crider 1999). Perchloroethylene production and handling facilities are shown on Figure 22.

The Perc Plant waste (called hex waste) consisted primarily of hexachlorobutadiene, hexachloroethane, hexachlorobenzene, and perchloroethylene. Prior to 1977, the hex waste was periodically removed from the process area and transported by truck to a pit lined with visqueen. The material was then cooled with water. The solidified material in the pit was exhumed annually and buried in the landfill area. A new hex pit was installed in 1972 north of the Perc plant across the railroad drainage ditch. This area was filled with clay and capped with concrete when it was closed in late 1977.

[21] Groundwater isoconcentration contour figures were not developed for vinyl chloride, hexachlorobenzene, 2-chlorophenol, and toluene because these compounds were not detected in groundwater at concetrations above the MCl and/or RSL.

In 1977 during the Waste Management Control Program, an incinerator was constructed for the treatment of the hex waste; eliminating the use of the hex pits. The incinerator ceased operations in 1997 (shortly after the closure of the Perc Plant) and was officially closed in accordance with Toxic Substances Control Act (TSCA) and RCRA requirements. Final closure was approved by KDHE on August 29, 1997.

Packaging and Non-Production Handling

A 1,1,1-trichloroethane-based product (Solvent III) was handled or stored at the Plant Rail Sites, Tank Farm, and Drum Filling Warehouse for future packaging and distribution (Crider 1999).

After the closure of the Perc Plant, trichloroethene was handled or stored at the Plant Rail Sites and Tank Farm (Crider 1999).

1,2-Dichloroethane (also known as ethylene dichloride or EDC) was handled or stored in the Flammable Drum Storage, Plant Rail Sites, Tank Farm, and R&D Pilot Plant (Crider 1999).

Vinyl chloride was handled or stored at the R&D Pilot Plant and Rail Site after the closure of the Perc Plant for development of new products. A trichloroethene-based product (AVA Triblend) was used in the R&D Pilot Plant (Crider 1999).

5.2.1.2 DISTRIBUTIONS IN SOIL

Perchloroethylene and hexachlorinated compounds were detected at concentrations above default soil saturation limits at several locations in the northern part of the facility. These areas are shown on Figure 21 and described in the sections below.

Perchloroethylene compounds were also detected in the vicinity of the Chloromethanes I Plant, the former Perc Plant, and the landfill. Perchloroethylene concentrations in soil are shown on Figure 23. Trichloroethene concentrations in soil are shown on Figure 24. Vinyl chloride concentrations in soil are shown on Figure 25. Isoconcentration maps showing the sample locations and analytical results are provided in Appendix I.

Hexachlorinated compounds were detected in the vicinity of the Chloromethanes I Plant, the former Perc Plant, and the landfill. Hexachlorobenzene concentrations in soil are shown on Figure 26. Hexachlorobutadiene concentrations in soil are shown on Figure 27. Hexachloroethane concentrations in soil are shown on Figure 28. 1,1,1-Trichloroethane concentrations in soil are shown on Figure 29. 1,2-Dichloroethane concentrations in soil are shown on Figure 30.

Perchloroethylene Potential DNAPL Areas

Soil samples collected from CM-22, CM-33, and CM-64 indicate concentrations of perchloroethylene above generic soil saturation limits. These boring locations are adjacent to the eastern and southeastern portion of the former Perc Plant.

A soil sample collected from CM-43 exceeded the default soil saturation limit for perchloroethylene at a depth of 5 to 7 feet bgs. Soil boring CM-43 was advanced in the former truck loading area to the area east of the drum filling and warehouse building.

A soil sample collected from location AR-1 at a depth of 30-32 feet bgs exceeded the default soil saturation limit for Perchloroethylene, hexachlorobenzene, and hexachlorobutadiene. The concentration of Perchloroethylene (975 mg/kg) was significantly higher than the concentration of hexachlorobenzene (1.7 mg/kg) or hexachlorobutadiene (57 mg/kg). The AR-1 soil boring is in close proximity to the former hex pits (described below).

A soil sample collected from location P7S exceeded the default soil saturation limit for Perchloroethylene. The P7S soil boring is located in the southeast portion of the landfill area. This area was identified as a "sump" in a 1986 analysis of a June 26, 1970 aerial photograph (USEPA 1986). However, there was no documented sump at this location, and anecdotal information suggests that this feature may have been a hex waste disposal trench.

Hexachlorinated Compound Potential DNAPL Areas Near the Former Penta Area

Hexachlorobutadiene, hexachloroethane, and hexachlorobenzene concentrations in PA-35c exceed their respective default soil saturation limits, which is an indication of the potential presence of DNAPL. Hexachlorobutadiene, hexachloroethane, and hexachlorobenzene are components of the "hex waste" generated during the production of perchloroethylene. There is no documented disposal of hex waste at this location, although this area is approximately 200 feet southeast of the Perc Plant.

Hexachlorinated Compound Potential DNAPL Areas Near Former Hex Quench Pits

Soil samples collected from CM-48, CM-55, CM-64, and CM-65 indicated concentrations of hexachlorobutadiene above generic soil saturation limits. Borings CM-48, CM-55, CM-64, and CM-65 are located in or near the Former Hex Pit Area SWMU {an area historically identified as containing "Hex dump pits" (Frontier 1971)} and a newer hex pit operated from 1972 to 1977. Moreover, DNAPL was reportedly identified in the MW019 monitoring well nest, which is located in this hex pit area.

DNAPL has also been identified in monitoring well MW-27S1. A sample of DNAPL collected from this well on February 19, 2009 indicated components of hex waste including hexachlorobutadiene (810,000 mg/kg), hexachloroethane (61,000 mg/kg), and hexachlorobenzene (7,000 mg/kg). Monitoring well MW-27S1 is located adjacent to the former hex pit which was located north of the Perc Plant and operated from 1972 to 1977.

Additionally, there are indications of the presence of DNAPL beneath the southwestern portion of the Arkema facility.

Hexachlorinated Compound Potential DNAPL Areas in the Landfill

From the opening of the Facility in 1952 until approximately 1977, solid wastes generated at the Facility were primarily disposed within the Site property. After the implementation of the pollution control program in 1977, on-Site landfilling of solid wastes other than construction debris was discontinued.

The landfill areas are located on an approximately 40-acre portion of the property east of the production portion of the Facility and are located east of the railroad tracks and north of 63rd Street. The landfill areas consist of three areas categorized by the wastes disposed, and these include the Alpha Cake Landfill, Hex Waste Pits, and Brine Ponds. The alpha cake landfill and hex waste pit areas compose the approximately southern half of the larger landfill area. These areas are categorized within the Permit as separate SWMUs within the Chemical Waste Landfill AOC. The approximate extents of these areas are shown on Figure 21.

Hexachlorinated compounds were detected at concentrations exceeding the RSK default soil saturation limit for hexachlorobutadiene, hexachloroethane, or hexachlorobenzene in borings C-02, C-06, C-07-3 (1987), and HX-03. DNAPL was also reportedly identified in MW-1S. These soil borings were located in the southern portion of the landfill area in the general vicinity of the known hex waste disposal pits.

5.2.1.3 EVALUATION OF GROUNDWATER DATA

Groundwater concentrations in excess of 1% of the aqueous solubility of an organic analyte are an indication that the contaminant may originate from a DNAPL source. Concentrations in excess of 10% of the aqueous solubility of an organic analyte are an indication of close proximity to the potential DNAPL source.

Perchloroethylene was detected at concentrations exceeding 1% of the aqueous solubility in groundwater samples collected from 24 monitoring wells. These wells are generally located at or downgradient of areas identified during the Phase I On-Site Groundwater Investigation, including the hex areas and perc areas identified on Figure 21. There is one exception[22]:

- **MW07S1** MW07S1 is located approximately 0.25 miles west (cross-gradient) of the OCC facility. This location has exhibited persistent detections of perchloroethylene over time at varying concentrations.

With the exception of MW07S1, the indications of DNAPL origin of perchloroethylene in groundwater are consistent with the potential DNAPL areas identified on Figure 21. Perchloroethylene concentrations in groundwater are shown on Figure 31. Trichloroethene was also detected in groundwater with a distribution similar to perchloroethylene, suggesting that it largely originates from the degradation of perchloroethylene in groundwater. Trichloroethene concentrations in groundwater are shown on Figure 32.

Hexachlorobenzene, hexachlorobutadiene, and hexachloroethane

Hexachlorobutadiene was detected at concentrations exceeding 1% of the aqueous solubility in groundwater samples collected from 30 groundwater sampling points. Hexachloroethane was detected at concentrations exceeding 1% of the aqueous solubility in groundwater samples collected from 10 groundwater screening sampling points[23]. These sampling points are generally located at or downgradient of areas

[22] Results of the October 2005 sampling event at DW-7 and DW-8 were excluded from this evaluation because they are considered spurious based on the lack of reproducibility from prior and subsequent monitoring events.

[23] Hexachlorobenzene is a solid at ambient temperatures and thus not an indicator of the potential origin from a DNAPL. Additionally, 1% of the aqueous solubility (0.0062/100=0.000062 mg/L) is substantially smaller than the MCL (0.001 mg/L) and is not a useful threshold for screening.

identified during the on-Site groundwater RFI Phase I investigation, including the hex areas identified on Figure 21. There are two exceptions:

- <u>**MW-07S1**</u> MW-07S1 is located approximately 0.25 miles west (cross-gradient) of the OCC facility. This location has exhibited persistent detections of hexachlorobutadiene and hexachloroethane over time at varying concentrations.
- <u>**MW016 Cluster**</u> The MW016 well cluster is located approximately 0.25 miles east (cross-gradient) of the OCC facility. This location has exhibited persistent detections of hexachlorobutadiene and hexachloroethane over time at varying concentrations.

With the exception of MW-07S1, and the MW016 well cluster, the indications of DNAPL origin of hexachlorobutadiene and hexachloroethane in groundwater is consistent with the potential DNAPL areas identified on Figure 21. Hexachlorobutadiene and hexachloroethane concentrations in groundwater are shown on Figures 33 and 34.

1,1,1-Trichloroethane and 1,2-dichloroethane concentrations in groundwater exhibit a distribution similar to that of hexachloroethane, indicating that these analytes may originate from the degradation of hexachloroethane in groundwater. 1,1,1-Trichloroethane concentrations in groundwater are shown on Figure 35. 1,2-Dichloroethane concentrations in groundwater are shown on Figure 36.

5.2.1.4 <u>INDICATORS REGARDING THE DATES OF RELEASE</u>

The Perc Plant operated from 1958 to 1996. Prior to 1977, hex waste was cooled in quench pits and then transported to the landfill for disposal in trenches. Each of the identified hex waste quench pit was identified as a potential DNAPL area on Figure 21. Additionally, the area of the landfill used for the trench disposal of hex waste was identified as a potential DNAPL area on Figure 21.

The facility implemented a Waste Management Control Program in 1977, which discontinued the use of hex waste quench pits and trench disposal in the landfill. Beginning in 1977, the hex waste was incinerated. The 1977 Waste Management Control Program implemented a variety of other waste handling improvements (e.g., stormwater management and off-Site waste disposal) which substantially minimized the potential for the release of perchloroethylene and related compounds to the environment.

The perchloroethylene identified adjacent to the east of the Perc Plant is generally mixed with carbon tetrachloride, indicating a mixed or co-located release prior to the cessation of the Chloromethanes I Plant in 1992 and likely prior to the implementation of the Waste Management Control program in 1977.

Additionally, perchloroethylene has been identified in monitoring wells upgradient from the facility (e.g., DW-03 and MW03S1), indicating that groundwater impacts had likely occurred prior to or during the period of groundwater flow reversal during the 1950s and early 1960s.

The documentation reviewed provides no indication that any release of perchloroethylene to the environment occurred after the implementation of the 1977 Waste Management Control Program.

5.2.2 CHLOROMETHANES

Chloromethanes are chlorinated hydrocarbons comprised carbon tetrachloride, chloroform, methylene chloride, and methyl chloride. At ambient temperatures carbon tetrachloride, chloroform, and methylene chloride are colorless liquids and methyl chloride is a gas. All the chloromethanes exhibit an ether-like odor.

5.2.2.1 OPERATIONAL HISTORY

The Chloromethanes I Plant (CLM I) began operations in 1956. In 1973 a methyl chloride plant was added to the CLM I Plant. The CLM I Plant ceased operations in 1992. The Chloromethanes II Plant (CLM II) began operations in 1978 and continues to operate as of the date of this report.

Chloromethanes are produced by the progressive chlorination of methane from natural gas:

$CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$ (methyl chloride)
$CH_3Cl + Cl_2 \rightarrow CH_2Cl_2 + HCl$ (methylene chloride)
$CH_2Cl_2 + Cl_2 \rightarrow CHCl_3 + HCl$ (chloroform)
$CHCl_3 + Cl_2 \rightarrow CCl_4 + HCl$ (carbon tetrachloride)

The reaction produces a mixture of the four chloromethanes which are then separated by distillation.

Carbon tetrachloride was handled or stored in the Drum Filling Warehouse, Labs, Plant Rail Sites, and Chlorine Unit in addition to the CLM I and CLM II production areas. Chloroform was handled or stored in the Chlorine Unit, Drum Filling Warehouse, Labs, and Plant Rail Sites in addition to the CLM I and CLM II production areas. Methylene chloride was handled or stored in the CLM II Plant, Drum Filling Warehouse, Plant Rail Sites, and Tank Area. Chloromethane (also called methyl chloride) was handled or stored in the Methyl Chloride Storage Area and Plant Rail Sites (Crider 1999). Chloromethane production and handling facilities are shown on Figure 37.

5.2.2.2 DISTRIBUTIONS IN SOIL

Carbon tetrachloride was detected at concentrations above default soil saturation limits in the northern part of the facility. This area is shown on Figure 21 and described in the section below.

Carbon tetrachloride and other chloromethanes were also detected at generally elevated concentrations in the vicinity of the former hex waste quench pits and the hex waste disposal trenches located in the landfill. Carbon tetrachloride concentrations in soil are shown on Figure 38. Chloroform concentrations in soil are shown on Figure 39. Methylene chloride concentrations in soil are shown on Figure 40.

Carbon Tetrachloride Potential DNAPL Area

Soil samples collected from CM-22, CM-33, and CM-64 indicate concentrations of carbon tetrachloride above the generic soil saturation limit. This area is located adjacent to the eastern portion of the former CLM I plant

The carbon tetrachloride, hexachlorobutadiene, hexachloroethane, and hexachlorobenzene concentrations in PA-35c exceed their respective RSK default soil saturation limits, which is an indication of the potential presence of DNAPL. PA-35 also exceeds the RSK default soil saturation limit for carbon tetrachloride.

5.2.2.3 EVALUATION OF GROUNDWATER DATA

Carbon tetrachloride was detected at concentrations exceeding 1% of the aqueous solubility in groundwater samples collected from 34 sampling locations. Chloroform was detected at concentrations exceeding 1% of the aqueous solubility in groundwater samples collected from nine sampling locations. Methylene chloride was detected at concentrations exceeding 1% of the aqueous solubility in groundwater samples collected from two sampling locations. Methyl chloride was detected at concentrations exceeding 1% of the aqueous solubility in groundwater samples collected from one sampling location. These wells are generally located near or downgradient of areas identified during the Phase I On-Site Groundwater Investigation, including the hex areas and carbon tetrachloride area identified on Figure 21. There are several exceptions:

- **MW030S3** MW030S3 exhibited high concentrations of carbon tetrachloride and is located on the southeast side of the grain silos and is generally upgradient of the OCC facility[24].
- **MW07S1** MW07S1 is located approximately 0.25 miles west (cross-gradient) of the OCC facility. This location has exhibited persistent detections of carbon tetrachloride, chloroform, and other analytes over time at varying concentrations.
- **MW016 well cluster** Monitoring wells MW016S2SS and MW016S2PVC exhibited persistent detections of carbon tetrachloride, chloroform, methylene chloride, and other analytes over time at varying concentrations.

With the exception of MW030S3, MW007S1, and the MW016S2 wells the indications of DNAPL origin of chloromethanes in groundwater is consistent with the potential DNAPL areas identified on Figure 21. Carbon tetrachloride concentrations in groundwater are shown on Figure 41. Chloroform concentrations in groundwater are shown on Figure 42. Methylene chloride concentrations in groundwater are shown on Figure 43.

5.2.2.4 INDICATORS REGARDING THE DATES OF RELEASE

The CLM I Plant operated from 1956 to 1992. The areas identified with high concentrations of chloromethanes (primarily carbon tetrachloride) are in close proximity to the CLM I production area or near former hex waste quench pits or hex waste disposal trenches. The hex waste quench pits and hex waste disposal trenches ceased operation in 1977. There are no known releases of chloromethanes after the implementation of the Waste Management Control Program in 1977.

[24] The MW030 monitoring well nest in the vicinity of the grain elevator indicated concentrations of carbon tetrachloride above 1% of the solubility limit, indicating the potential for DNAPL to be present. This location is upgradient from the OCC Facility and likely originates from a source in the vicinity of MW030. Moreover, the relative absence of chloroform or other chemicals potentially associated with the OCC plant indicates that this groundwater source maybe unrelated to the OCC facility.

The CLM II Plant began operating in 1978 and continues to operate as of the date of this report. The only chloromethane detections near the CLM II Plant are associated with the former hex quench pit which predated the construction of the CLM II Plant. There are no known releases of chloromethanes after the implementation of the Waste Management Control Program in 1977.

5.2.3 PENTACHLOROPHENOL AND RELATED COMPOUNDS

Pentachlorophenol is a greenish-gray crystalline solid at ambient temperatures and was sold for use as a wood preservative. Other chlorophenols such as 2,3,4,6-tetrachlorophenol, 2,4,6-trichlorophenol, 2,4-dichlorophenol, and 2-chlorophenol may be formed during the production of pentachlorophenol or via its subsequent degradation in the environment.

5.2.3.1 OPERATIONAL HISTORY

The Facility constructed an Herbicide Plant in approximately 1957 for production of 2,4-D and pentachlorophenol. Pentachlorophenol production at the facility began in 1958 and ceased in June 2005. Pentachlorophenol was produced at the Site by the chlorination of phenol. The resulting product contains approximately 84-90% pentachlorophenol and 10-16% other polychlorinated phenols. Pentachlorophenol production and handling facilities are shown on Figure 44.

Pentachlorophenol was handled or stored in the Penta Storage Area, the Penta Plant, and the R&D Lab (Crider 1999).

2,4,5- and 2,4,6-Trichlorophenols were handled or stored in the Penta Plant. Chlorophenols (o-, m-, and p-) and dichlorophenols (2,4-, 2,5-, and 2,6-) were handled or stored in the Drum Filling Warehouse, Labs, Plant Rail Sites, and Chlorine Unit in addition to the CLM I and CLM II production areas (Crider 1999). Phenol was handled or stored in the Plant Rail Sites and the Penta Plant.

5.2.3.2 DISTRIBUTIONS IN SOIL

Pentachlorophenol was detected at concentrations above default soil saturation limits at one location in the northern part of the facility. This area is shown on Figure 21 and described in the section below.

Pentachlorophenol and related compounds were also detected at generally elevated concentrations in the eastern portion of the CLM I Plant, the truck loading area, the eastern hex waste quench pit, and in the landfill area. Pentachlorophenol concentrations in soil are shown on Figure 45. 2,3,4,6-tetrachlorophenol concentrations in soils are shown on Figure 46. 2,4,6-trichlorophenol concentrations in soil are shown on Figure 47. 2,4-dichlorophenol concentrations in soil are shown on Figure 48. 2-chlorophenol concentrations in soil are shown on Figure 49.

Pentachlorophenol Potential DNAPL Area

The pentachlorophenol concentration in PA-54 (1-3 feet bgs) exceeds the RSK default soil saturation limit of 696 mg/kg, which is an indication of the potential presence of DNAPL or a free-phase solid. The PA-54 soil boring is located adjacent to the pentachlorophenol production area.

5.2.3.3 EVALUATION OF GROUNDWATER DATA

Pentachlorophenol was detected at concentrations exceeding 1% of the aqueous solubility in groundwater samples collected from 6 monitoring locations. 2,3,4,6-Tetrachlorophenol was detected at concentrations exceeding 1% of the aqueous solubility in groundwater samples collected from four monitoring locations. 2,4,6-Trichlorophenol was detected at concentrations exceeding 1% of the aqueous solubility in groundwater samples collected from one monitoring location. These wells are generally located at or downgradient of areas identified during the on-Site groundwater RFI Phase I investigation, including the northern hex area, pentachlorophenol area, and the landfill areas identified on Figure 21. The one exception is:

- **MW016 well cluster** Monitoring wells MW016S2SS and MW016S2PVC exhibited persistent detections of pentachlorophenol, 2,3,4,6-tetrachlorophenol, and 2,4,6-trichlorophenol over time at varying concentrations.

Polychlorinated phenols[25] are solids at ambient temperatures and will only form DNAPLs when other organic solvents are present. With the exception of the MW016 cluster, the distribution of chlorophenols in groundwater is consistent with the high

[25] 2-chlorophenol is a liquid at ambient temperatures.

concentration areas identified on Figure 21. Pentachlorophenol and related compound concentrations in groundwater are shown on Figures 50, 51, 52, and 53.

5.2.3.4 INDICATORS REGARDING THE DATES OF RELEASE

The Penta Plant operated from 1958 to 2005. There are no known releases of pentachlorophenol or related compounds after the implementation of the Waste Management Control Program in 1977.

5.2.4 BENZENE HEXACHLORIDE (BHC)

Benzene hexachloride (BHC), also known as 1,2,3,4,5,6-hexachlorocyclohexane (HCH) is a synthetic aromatic hydrocarbon with a chemical formula of $C_6H_6Cl_6$. Gamma-BHC is a BHC isomer that was manufactured as an insecticide for fruit, vegetables, forest crops, and animals and animal premises (ATSDR 2005, p. 2). BHC can occur in eight isomer configurations, four of which (α, β, γ, and δ) are of commercial significance (ATSDR 2005, p. 173). Gamma-BHC is the only isomer with significant insecticidal properties (Vijgen 2006). The remaining isomers are called "inactive" isomers.

Several mono-aromatic compounds were also identified in soil and groundwater at the Site. These compounds include the hydrocarbons benzene and toluene, and the chlorinated hydrocarbons 1,2,4-trichlorobenzene, 1,2-dichlorobenzene, 1,4-dichlorobenzene, and chlorobenzene.

5.2.4.1 OPERATIONAL HISTORY

BHC is produced by the chlorination of benzene. This reaction produces a mixture of BHC isomers containing about 14-15% gamma, 65-70% alpha, 7-10% beta, 7% delta, and 1-2% epsilon isomers. This material is called raw BHC when it is a process intermediate and technical grade BHC when it is a product (Vijgen 2006).

From 1952 to 1962 the facility produced "High Gamma BHC" (Wilson 1976, p. 4-1), which can also be referred to as enriched or refined BHC. High Gamma BHC is produced by cooling the raw BHC reaction mixture until the inactive isomers crystallize. The inactive isomers are then removed by filtration. The resulting product contains approximately 40% gamma-BHC. The filtrate is a waste called alpha cake and is composed largely of alpha-BHC (Vijgen 2006).

Gamma-BHC can also be produced to a highly purified form called Lindane. The pesticide Lindane is composed of greater than 99% gamma-BHC (ATSDR 2005, p. 173). Lindane is produced by the extraction of gamma-BHC from raw BHC using methanol (Vijgen 2006, p. 13).

The BHC Plant was located in what is currently the southern portion of the Chloromethanes I, II, and Perc AOC. BHC product was stockpiled on the ground east of the administration building (north of the warehouse) and to the north west of the BHC plant prior to packaging in the adjacent warehouse. The warehouse was used for storing "Agricultural Chemical[s]" (Frontier 1971) which encompassed the products generated at the BHC, 2,4-D, and Penta plants. BHC production and handling facilities are shown on Figure 54.

The alpha cake, which was the byproduct of the Lindane and BHC manufacturing processes, was disposed of in the southeastern portion of the landfill located to the east of the railroad tracks. Wastewater from the BHC Plant was pumped to the old Solar Pond, which was later excavated and disposed of in the landfill.

Gamma-BHC can degrade to alpha- or beta-BHC in soil and groundwater. Alpha-BHC can degrade to beta-BHC. Moreover, the all equatorial configuration of beta-BHC may provide greater resistance to hydrolysis and enzymatic degradation (Vallero 2003, p. 102), and it is generally considered the most persistent isomer. BHC degradation products can include hydroquinone, dichlorophenol, and trichlorobenzene (Morrison and Murphy 2006, p. 154). The biological degradation of BHC can produce pentachlorocyclohexane, tetrachlorobenzene, and trichlorophenol (Vulcan Chemical 1986, p. 11).

<u>Benzene and Related Compounds, Petroleum Fuels and Oils</u>

Benzene was used as a raw material in the production of BHC and is a common component of petroleum fuels. Toluene can be present as a contaminant in benzene feedstocks and is also a common component of petroleum fuels. The chlorobenzenes 1,2,4-trichlorobenzene, 1,2-dichlorobenzene, 1,4-dichlorobenzene, and chlorobenzene can be formed as the result of production of perchloroethylene or BHC, either as a byproduct of the manufacturing process or by *in situ* degradation.

Diesel fuel (#1 and #2) was handled or stored in the transportation lot, switch engine fuel storage, fire pump building, and power plant area. Gasoline was also handled or stored in the transportation area (Crider 1999).

There are documented releases from underground storage tanks (USTs) that contained gasoline, diesel, or waste motor oil. These USTs were removed from the facility prior to 1999. There are no documented releases from the two current USTs which are permitted through KDHE.

A 1.2 million gallon capacity #6 fuel oil AST was installed on the east side of the tracks in 1976. This AST was reportedly taken out of service and cleaned in the early 1980s. The AST was demolished and petroleum-impacted soil was excavated for off-Site disposal in 2000 (IT Corp. 2002).

Lubricating oil (6301 oil) was handled or stored in the chlorine plant. Heat transfer oil (Mobiltherm oil) was handled or stored in the drum storage area and the VFS Plant (Crider 1999). Motor oil was handled or stored in the Warehouse, the Transportation and Maintenance Shop, and various Oiler Stations. Transformer oils are also present in transformers at the facility {all have been verified as non-polychlorinated biphenyl (PCB) containing transformers}.

5.2.4.2 DISTRIBUTIONS IN SOIL

BHC isomers are present in solid form (alpha cake) in the southeastern portion of the landfill. This area is shown on Figure 21.

BHC isomers were also detected at generally elevated concentrations in the vicinity of the former BHC Plant, the truck loading area, and generally near the landfill. Alpha-BHC concentrations in soil are shown on Figure 55. Beta-BHC concentrations in soil are shown on Figure 56. Gamma-BHC concentrations in soil are shown on Figure 57.

Generally elevated concentrations of benzene, chlorobenzene, 1,2-dichlorobenzene, 1,4-dichlorobenzene, 1,2,4-trichlorobenzene and toluene in soil were identified in the landfill area. The elevated concentrations in the landfill area are collocated with the alpha cake disposal area. There is historic anecdotal evidence that the alpha cake pile contained some benzene (Vulcan 1981). A small area of elevated concentrations of benzene has also been identified adjacent to the railroad tracks. Benzene concentrations in soil are shown on Figure 58. Toluene concentrations in soil are shown on Figure 59.

5.2.4.3 EVALUATION OF GROUNDWATER DATA

Gamma-BHC was detected at concentrations exceeding 1% of the aqueous solubility in groundwater samples collected from one monitoring location (IW31). This well is generally located at or downgradient of the alpha cake portion of the landfill area identified on Figure 21. Alpha-BHC concentrations in groundwater are shown on Figure 60. Beta-BHC concentrations in groundwater are shown on Figure 61. Gamma-BHC concentrations in groundwater are shown on Figure 62. Potential groundwater sources of BHC isomers include the former BHC Plant area in addition the alpha cake portion of the landfill. Additionally, non-point sources of BHC isomers in groundwater are also indicated to the northeast of the facility[26]. As discussed previously, gamma-BHC is susceptible to *in situ* degradation to alpha-BHC which in turn is susceptible to degradation to beta-BHC. Based on the inactive (non-gamma) BHC isomer groundwater isoconcentration contours, it is apparent that the alpha and beta isomers predominate in groundwater beyond the Facility boundary.

A review of the benzene concentrations in groundwater indicates that the southern portion of the landfill is the most likely origin point. Benzene concentrations in groundwater are shown on Figure 63.

5.2.4.4 INDICATORS REGARDING THE DATES OF RELEASE

The BHC Plant operated from 1952 to 1962. Stormwater was contained at the Site beginning in 1977. The alpha cake in the landfill area was capped in 1977. There are no known releases of BHC after the capping of the landfill in 1977.

Although alpha cake remains in the landfill area, its potential to impact groundwater has been minimized by the low permeability soil cap and runoff controls.

Benzene and related compounds are generally associated with the alpha cake disposal in the southern portion of the landfill area. The alpha cake was produced during the operation of the BHC Plant from 1952 to 1962. The landfill area was capped in 1977. There are no known releases of benzene after the capping of the landfill in 1977.

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[26] It appears unlikely that the eastern plume shown on Figure 61 has separated from the plant area plume due to degradation or any other attenuation mechanism. The eastern plume likely originates from a location that is independent from the plant under the current or any known historic flow regime.

5.2.5 2,4-DICHLOROPHENOXY ACETIC ACID, (2,4-D)

2,4-Dichlorophenoxyacetic acid (2,4-D) is a broadleaf herbicide which was commercially released in 1946. 2,4-D is a white to yellow powder at ambient temperatures.

5.2.5.1 OPERATIONAL HISTORY

The facility constructed an Herbicide Plant in approximately 1957 for production of 2,4-D and pentachlorophenol. 2,4-D production began in 1957 and ceased in 1959. 2,4-D production and handling facilities are shown on Figure 64.

2,4-D was produced using acetic acid, phenol, and chlorine as raw materials. The chlorination of the acetic acid and phenol produces chloroacetic acid and 2,4-dichlorophenol respectively as process intermediaries.

$CH_3COOH + Cl_2 \rightarrow HCl + ClCH_2COOH$ (chloroacetic acid)
$C_6H_5OH + Cl_2 \rightarrow H_2 + C_6H_3Cl_2OH$ (2,4-dichlorophenol)

2,4-D is then produced by the reaction of chloroacetic acid and 2,4-dichlorophenol.

$ClCH_2COOH + C_6H_3Cl_2OH \rightarrow HCl + C_6H_3Cl_2OCHCOOH$ (2,4-D)

2,4-D production contaminants can include dichlorophenoxyacetic acid isomers, chlorophenols, and dioxins. However, it is noted that in spite of extensive monitoring in dioxins during the 2008 Appendix IX groundwater sampling event, they were generally never observed at this facility as a groundwater contaminant. The typical smell associated with 2,4-D is actually due to the break-down product 2,4-dichlorophenol. The solar pond received wastewater from the 2,4-D Plant.

5.2.5.2 DISTRIBUTIONS IN SOIL

The distribution of 2,4-D concentrations in soil is shown on Figure 21. The 2,4-D distribution indicates that generally elevated concentrations occur near the 2,4-D production area, the old solar pond, and the northern portion of the landfill. 2,4-D concentrations in soil are shown on Figure 65.

2,4-D Production Area

The 2,4-D production area was located in the southern section of the Penta Area AOC and adjacent to the former Penta Plant.

Old Solar Pond

The Old Solar Pond received wastewater from the 2,4-D production area and other units. In 1976 the Old Solar Pond and underlying clay was excavated transported and disposed in the brine pond portion of the landfill.

Soil borings IA-03 through IA-08 were advanced in the vicinity of the old solar pond. Soil samples identified 2,4-D concentrations up to 2.6 mg/kg.

Landfill

Excess wastewater in the Old Solar Pond was directed to the lagoon area of the landfill. In 1976 the old solar pond and underlying clay was excavated and disposed of in the brine pond portion of the landfill.

5.2.5.3 EVALUATION OF GROUNDWATER DATA

2,4-D was detected at concentrations exceeding 1% of the aqueous solubility in groundwater samples collected from two sampling locations. One of these wells MW29S2 is located downgradient of the northern portion of the landfill where the Old Solar Pond sediments were buried. The second location is the MW016 well cluster. 2,4-D concentrations in groundwater are shown on Figure 66. The 2,4-D concentrations in groundwater are generally downgradient of the soil impacts at the former 2,4-D Plant, the Old Solar Pond, and the landfill area.

5.2.5.4 INDICATORS REGARDING THE DATES OF RELEASE

The 2,4-D Plant operated from 1957 to 1959. The Old Solar Pond which received waste from the 2,4-D Plant was excavated in 1977 and transported to the northern portion of the landfill area for disposal. The landfill itself was capped in 1977. There are no known releases of 2,4-D after the capping of the landfill in 1977.

5.2.6 CHLOROPROPANES

1,2-Dichloropropane is a colorless liquid with a chloroform-like odor. It is moderately soluble in water and readily evaporates into air.

5.2.6.1 OPERATIONAL HISTORY

In 1997, Vulcan opened the Vulcan Feed Stock (VFS) plant at the former location of the Perc Plant. The VFS plant produced 1,1,1,3,3-pentachloropropane (also called VFS 8648.50 or 5CP) which is a process intermediary used for the production of HFC-245fa, a replacement refrigerant for products containing fluorocarbon refrigerants. The VFS plant produced 1,1,1,3,3-pentachloropropane by the reaction of carbon tetrachloride and vinyl chloride in the presence of a catalyst (Crider 1999 and OxyChem 2009).

$$CCl_4 + C_2H_3Cl \rightarrow CCl_3CH_2CCl_2H \qquad \text{(1,1,1,3,3-pentachloropropane)}$$

1,2-dichloropropane may be formed as an impurity during the production of 1,1,1,3,3-pentachloropropane.

The VFS plant was subsequently closed in 2002 and all production was moved to another OCC facility.

Small amounts of chlorinated propanes could also be produced as byproducts of the chloromethane or perchloroethylene production processes due to trace amounts of propane in the natural gas or other feed stocks.

5.2.6.2 DISTRIBUTIONS IN SOIL

Two areas have been identified with generally elevated concentrations of chloropropanes in soil. One area is in the vicinity of the CLM I plant (just south of the VFS Plant). A second area is located in the shipping area in the Penta and Shipping Area AOC. 1,2-Dichloropropane concentrations in soil are shown on Figure 67.

5.2.6.3 EVALUATION OF GROUNDWATER DATA

1,2-dichloropropane was detected at concentrations exceeding 1% of the aqueous solubility in a groundwater screening sample collected from only one sampling location.

This sampling location (CPT-9 at 54-55 feet bgs) is located downgradient from the former VFS Plant, Perc Plant, and CLM I Plant areas. 1,2-dichloropropane concentrations in groundwater are shown on Figure 68. The 1,2-dichloropropane concentrations in groundwater are generally downgradient of the areas containing elevated concentrations of chloropropanes in soil.

5.2.6.4 INDICATORS REGARDING THE DATES OF RELEASE

Chloropropanes may have originated in the CLM I or Perc/VFS Plant areas. The CLM I Plant operated from 1956 to 1992, the Perc Plant operated from 1958 to 1996, and the VFS plant operated from 1997 to 2002.

There are no known releases of chloropropanes after the implementation of the Waste Management Control Program in 1977.

5.2.7 CHLOROFLUOROCARBONS (CFCS)

Trichlorofluoromethane (CFC-11) is a chlorofluorocarbon (CFC) and is used as a refrigerant. Trichlorofluoromethane was detected in soil and groundwater at the facility.

5.2.7.1 OPERATIONAL HISTORY

The facility used chlorodifluoromethane (HCFC-22) as a refrigerant in heat exchanging equipment in the Penta Plant and CLM II Plant, and stored in the warehouse. Dichlorodifluoromethane (CFC-12) was used as a refrigerant in heat exchanging equipment in the Chlor-alkali Plant, the tank area, and stored in the warehouse. 1,2-Dichlorotetrafluoroethane (CFC-114) was used as a refrigerant in heat exchanging equipment in the Chlor-alkali Plant and stored in the warehouse. 1,1,1,2-Tetrafluoroethane (HFC-134a) was used as a refrigerant in heat exchanging equipment in the Chlor-alkali Plant and the boiler house (Crider 1999).

There is no indication that the facility used or released trichlorofluoromethane (CFC-11).

Arkema Facility

The adjacent Arkema facility produced refrigerants[27], namely CFCs including trichlorofluoromethane (R-11), trifluorotrichloroethane (R-113), and dichlorodifluoromethane (R-12), chlorotrifluoromethane (R-13), dichlorofluoromethane (R-21), chlorodifluoromethane (R-22), and trifluoromethane (R-23). Chlorodifluoromethane (R-22) was the principal product of the facility. The Arkema facility also received refrigerants for blending, packaging, and redistribution, including R-32, R-113, R-114, R-115, R-123, R-124, R-125, R-134a, R-142b, R-143a, and R-152a (ERM 2010).

The principal raw materials used at the Arkema facility were chloroform (raw material for R-22), carbon tetrachloride (raw material for R-11 and R-12), and hydrogen fluoride (source of fluorene). Other materials used at the facility include antimony pentachloride (catalyst), hydrochloric acid (produced in dechlorination processes), sulfuric acid, chlorine, sulfur dioxide, arsenic, methylene chloride, sodium hydroxide, potassium hydroxide, sodium carbonate, ethylene glycol, sodium phosphates, sodium sulfates, lime, paints and solvents, and oil and diesel fuel (ERM 2010).

Investigations of the Arkema facility indicated that various CFC products were released to soil and groundwater at the Arkema facility. The OCC facility did not produce CFCs.

5.2.7.2 DISTRIBUTIONS IN SOIL

Trichlorofluoromethane was only identified in soil at the perimeter of the Arkema facility, with the highest concentration (42 mg/kg) at AR-1.

Trifluorotrichloroethane (CFC-113) and dichlorodifluoromethane (CFC-12) were also detected in soil, but at concentrations not expected to cause groundwater impacts.

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[27] The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) refrigerant number (R-x) plus 90 results in a three digit number with the digits representing the number of carbon, hydrogen, and fluorene atoms respectively (with any remaining bonds occupied by chlorine). The ASHRAE R-prefix is commonly replaced by the term Freon (DuPont's brand name) or the chemical type, (such as CFC for chlorofluorocarbon). Thus R-11, Freon-11, and CFC-11 all refer to trichlorofluoromethane.

5.2.7.3 EVALUATION OF GROUNDWATER DATA

The highest concentrations of CFCs in groundwater are present beneath the adjacent Arkema facility.

5.2.7.4 INDICATORS REGARDING THE DATES OF RELEASE

The trichlorofluoromethane concentrations are associated with the adjacent Arkema facility. The Arkema facility began producing refrigerants in 1965 and ceased operation in 2002.

5.3 SUMMARY

An evaluation of the timing of the releases indicates that soil contamination present at the Site generally originates from pre-1980 operations. There are several implications of the determination that the source areas generally originated from historical plant operations rather than recent activities. These implications include:

- the potential for further DNAPL migration is likely minimal due to the time elapsed and saturation approaching residual levels;
- based on the data evaluated herein, DNAPL removal potential may be limited due to the residual saturation levels of DNAPL, the high molecular weight of some of the DNAPL component compounds, the complex geology and presence of low permeability units, and the depth of the underlying aquifer system; and
- the potential for direct contact exposure is limited by the existing plant impervious surfaces.

6.0 DISCUSSION AND RECOMMENDATIONS

In the previous sections of this report the results from Phase I of the On-Site Groundwater Investigation were presented and evaluated. The evaluation included the following:

- on-Site and off-Site hydrogeology;
- updated conceptual site model;
- soil boring observations and analytical results;
- dye test results and other potential NAPL indicators;
- CPT testing results;
- groundwater screening results;
- groundwater contaminant source evaluation; and
- groundwater ICM re-assessment.

Based on the evaluation of these items in conjunction with known Facility operations and the myriad data developed since the date of this report, the recommendations for enhancements to the groundwater ICM and for Phase II of the on-Site groundwater investigations are presented in the following sections.

6.1 PROPOSED PHASE II ACTIVITIES

The specific objectives for Phase I of the on-Site groundwater investigation were to:

- Identify and delineate areas where DNAPL has previously been identified.
- Further define the subsurface geology beneath the main facility area of the Site.
- Further define the groundwater quality beneath the main facility area of the Site.
- Further define the subsurface geology in the areas surrounding the Site.

Based on the evaluation of the data collected during Phase I of the investigation, the objectives of the investigation have largely been achieved.

In general, the information collected during the focused soil boring program in conjunction with the other Site-related data have adequately delineated the horizontal limits of the potential NAPL areas with the possible exception of CPT-8. The proposed scope of work for Phase II will therefore progress upgradient from CPT-8 with a focus on horizontal delineation in the vicinity of SWMUs[28] associated with the Facility's Research and Development building, vertical delineation of the areas where the potential presence of NAPL has been identified, and an assessment of the mobility and recoverability characteristics of identified DNAPL.

6.1.1 PHASE II NAPL DELINEATION

Supplemental Horizontal Delineation Program

In order to evaluate the potential presence of DNAPL upgradient of CPT-8, additional borings will be advanced to the top of the C3 clay (consistent with the methods employed for the Phase I Investigation focused soil borings) in the area north-northwest of CPT-8[29]. Figure 69 illustrates proposed Phase II delineation boring locations.

Deeper Soil Boring Program

The proposed Phase II NAPL vertical delineation program consists of the installation of deeper soil borings down to the C2 and/or C1 clay layers to vertically delineate the limits of the potential NAPL (or free phase solid) areas identified during the Phase I investigation (and described in Section 5.0).

Phase I soil borings advanced near monitoring well nests MW18 and MW27 did not identify indicators of the potential presence of NAPL at the S4 sand unit and C3 clay unit interface. However, NAPL has been identified in some of these wells in the past, and Phase II investigations will be conducted near these monitoring well nests to investigate the potential for a deeper source of NAPL at these locations.

Phase II vertical delineation borings in areas where overlying NAPL is suspected will involve the use of rotary sonic drilling methods where temporary isolation casings can be utilized to minimize vertical contaminant migration during drilling. The following provides a summary of the procedures to be followed:

- A nominal 6-inch soil boring (nominal 4-inch inner casing/6-inch outer casing) will be advanced approximately 2 feet into the top of the C3 clay layer using rotary sonic drilling methods. Phase I soil boring logs will be utilized to aid in determining the depth to the C3 clay and to ensure that the C3 clay layer is not completely penetrated

[28] Hazardous waste container storage - R&D, and R&D Hazardous Waste Tanks.
[29] These borings will also evaluate the potential presence of contaminants relative to R&D building SWMUs.

prior to inspecting/testing this interval for the presence of potentially mobile NAPL (observations of pooled NAPL, staining, or sheen).

- Representative soil samples will be continuously sampled to the top of the C3 clay stratigraphic unit. A trained geologist will log and describe the soils using the USCS. The collected soil samples will also be screened at 2-foot intervals with a PID using headspace monitoring techniques. If PID monitoring or olfactory evidence indicates the possible presence of NAPL above the S4/C3 interface, a representative sample of this interval will be field dye tested using Oil Red O hydrophobic dye to confirm the presence of NAPL.
- A dye test will be performed on a sample at the S4 sand unit and C3 clay unit interface interval to test for the potential presence of NAPL. If a positive dye test or other indications of NAPL (observations of pooled NAPL, staining, or sheen) are observed at or above the S4/C3 interface, a nominal 10-inch temporary over-shot casing will be advanced to this interval (over the 6-inch casing) to prevent the downward migration of NAPL prior to continuing drilling the 6-inch borehole.
- If signs of NAPL are not observed at or above the C3/S4 interface, a temporary casing will not be used, and the 6-inch soil boring will be advanced to the next clay layer or NAPL interval. Representative soil samples will be continuously sampled to the top of the next clay stratigraphic unit or NAPL interval. Collected soil samples will be inspected, logged, and screened at 2-foot intervals with a PID using headspace monitoring techniques. If PID monitoring or olfactory evidence indicates the possible presence of NAPL, a representative sample of this interval will be field dye tested using Oil Red O hydrophobic dye to confirm the presence of NAPL.
- The procedures outlined above will continue until the borehole is advanced to bedrock or until a deeper interval of potentially NAPL is encountered. If, during drilling activities signs of potentially NAPL (observations of pooled NAPL, staining, or sheen) are observed, a nominal 10-inch temporary over-shoot casing will be advanced to this interval to prevent the downward migration of NAPL prior to continuing drilling the 6-inch borehole. In the event that a second zone of potentially NAPL is encountered, the soil boring will be terminated at this depth to prevent any potential vertical migration.
- During drilling activities soil samples will be collected for chemical analysis from intervals exhibiting signs of potential NAPL. Soil samples will be analyzed for the standard Site COC[30] list of parameters.

[30] COC list as set out in the Sampling and Analysis Plan Routine Groundwater Sampling Plan RCRA Corrective Action Program March 9, 2012.

- The completed deep soil borings will be abandoned by filling the borehole with a cement/bentonite grout emplaced using a tremie pipe as the sonic casing is withdrawn from the borehole.

Figure 69 illustrates the proposed locations of the Phase II shallow (upgradient of CPT-8) and deeper (C2 and C1) soil borings.

6.1.2 DNAPL MOBILITY AND RECOVERABILITY EVALUATION

The Phase II investigation will include the collection of soil core and DNAPL samples to support an analysis of DNAPL mobility and recoverability. For each "focus area" identified on Figure 21, cores will be collected through the depth interval associated with DNAPL indicators or high analyte concentrations for photography under white and ultraviolet light. The depth interval with the highest indication of impairment will be selected for the following additional analysis:

-Initial and residual water and DNAPL saturation

-Bulk density

-Particle density

-Total organic carbon (unimpaired intervals only)

-Porosity (air-filled, water-filled, DNAPL-filled)

-Hydraulic conductivity

-Specific permeability (air and water)

-Grain size distribution

Additionally, if sufficient volume of DNAPL can be collected, it will be submitted for analysis of the following physical parameters:

-Viscosity

-Density

-Interfacial/surface tension

6.2 GROUNDWATER ICM ENHANCEMENTS

Section 4.6 re-evaluated the effectiveness of the current groundwater ICM. This evaluation concluded that the current groundwater ICM for the S1 basal aquifer appears to be operating highly effectively to contain and capture impacted groundwater within the S1 aquifer. Based on this current evaluation, no additional modifications or enhancements to the groundwater ICM for the S1 aquifer are proposed.

The evaluation identified that enhancement to the S2/S3 aquifer groundwater ICM may be beneficial. This conclusion is based on the following:

- Stratigraphic information obtained during the off-Site CPT program has identified the thickening of the S2/S3 aquifer from approximately 20 feet in thickness beneath the OCC Facility to nearly 60 feet in thickness to the south near 71st Street. This thickening of the S2/S3 aquifer to the southeast in the downgradient direction results in a direct increase in the transmissivity of the aquifer.
- Concentrations of carbon tetrachloride in several S2/S3 monitoring wells located to the east of Hoover Road have been slowly increasing or, in the case of MW138 S2/S3, are now being detected at concentrations above the laboratory detection limit.
- As discussed in Section 5.0, routine semi-annual groundwater monitoring data and the results from the September 2012 Geoprobe groundwater screening event indicate that COCs detected to the east of the OCC Facility, including carbon tetrachloride, may be emanating from a separate source area located to the northeast of the OCC Facility.

Based on the above, the following section identifies the proposed modifications to the groundwater ICM associated with the S2/S3 aquifer.

6.2.1 PROPOSED INTERCEPTOR WELL NETWORK ENHANCEMENTS

In order to enhance the capture zone of IW44, a supplemental extraction well, IW45, is proposed. The potential location for this supplemental well is to the south and east of IW44 (see Figure 70).

To address the indications of persistent and/or increasing concentrations of COCs to the east of Hoover Road, the installation of a supplemental interceptor well, IW46, is proposed. The potential location for this supplemental interceptor well is to the east of Hoover Road (see Figure 70).

Permits for IW45 and IW46 will include Water Use Permits for the new interceptor wells. Each interceptor well will be controlled by a Programmable Logic Controller (PLC). The flow and water level will be monitored by the PLC and can be logged by a supervisory, control and data acquisition computer (SCADA PC). Communication from the new interceptor wells to the SCADA PC will be accomplished via radio telemetry. The new equipment will be integrated with the Wichita plant and the existing extraction and deep well disposal network.

6.2.1.1 PROCESS DESCRIPTION

New Interceptor Wells

The new interceptor wells will be designed with a 24-diameter borehole advanced to a depth of approximately 85 feet below grade with the final depth based on local stratigraphy. The construction of the new interceptor wells will include 20 feet of 16-inch diameter steel-slotted well screen and approximately 65 feet of steel riser pipe. The riser pipe will be protected by a 24-inch diameter well cover.

The new interceptor wells will be configured with "environmental duty" submersible pumps and a variable speed drive to allow adjustment of the pumping rate.

New Interceptor Well Houses

Interceptor well houses will be constructed of 2-inch tubular aluminum on 16-inch centers with a 0.060-inch aluminum skin on the exterior and interior. Instrumentation and pump controls will be located in the well houses, which will be located adjacent to each of the new interceptor wells. Each well house will be installed on a concrete pad that has a flange fitting located approximately 6 inches above the top of the pad, in one corner, for discharge to the treatment system. Communication from the new interceptor well houses to a PLC will be via radio telemetry with start/stop control and monitoring data available.

6.2.1.2 EQUIPMENT AND INSTRUMENTATION

Flow Transmitters

The flow transmitter for the new interceptor wells will be located in the well house adjacent to the newly constructed interceptor wells. The assembly will consist of a transmitter and a flow cell. The transmitter will send a signal to the PLC for monitoring and controlling the rate of groundwater recovery from the new interceptor well.

<u>Level Transmitters</u>

Both new interceptor wells will be configured with down-well pressure transducers that are configured with polyurethane- and Kevlar-lined down-well cables (with a vent tube), and have a 4-20mA output with 0-30 psig range. The transducer output signal will be transmitted to the PLC for groundwater level monitoring and pump control.

<u>New Interceptor Well Groundwater Recovery Pumps</u>

Both new interceptor wells will have a Grundfos "environmental duty" pump rated up to 200 gallons per minute (gpm), which will be controlled by a variable speed drive.

<u>Alarms</u>

The control system will be designed to allow the process to be operated in fail-safe mode, monitored by the PLC. As for IW43 and IW44, the major alarm condition will be power disruption or failure. Also, the alarm notification will be to the operator through the PLC processor display screen. An autodialer, which will be independent of the PLC, will be included and will be available for use to allow for remote notification of alarm conditions.

6.2.2 SUPPLEMENTAL WATER MANAGEMENT

As discussed by the Conceptual Design, Groundwater ICM Modification Report (CRA 2011e), a separate water treatment system is contemplated to handle supplemental interceptor well effluent. The potential groundwater treatment system will be similar to the granular activated carbon (GAC) treatment systems currently in use to treat the groundwater extracted from IW41 and IW42. The treatment system will use GAC to treat groundwater from IW40 and IW44. The treatment system will be sized to accommodate the groundwater extracted from the additional interceptor wells, IW45 and IW46.

The treated groundwater would be discharged to the surface under the Facility's existing National Pollutant Discharge Elimination System (NPDES) Permit.

6.3 SCHEDULE

- Following Phase I summary report approval by the USEPA, Phase II activities will commence within 60 days of receipt of the USEPA's approval of the Phase I summary report.
- CPT-8 delineation boring activities will be implemented concurrently with "new" SWMU investigation borings referenced by the Facility's Class I Permit Modification dated November 14, 2012.
- Phase II activities will be completed and the results summarized and submitted to the USEPA (along with recommendations for any potential Phase III scope of work) within 60 days following validation of the Phase II laboratory data.

7.0 REFERENCES

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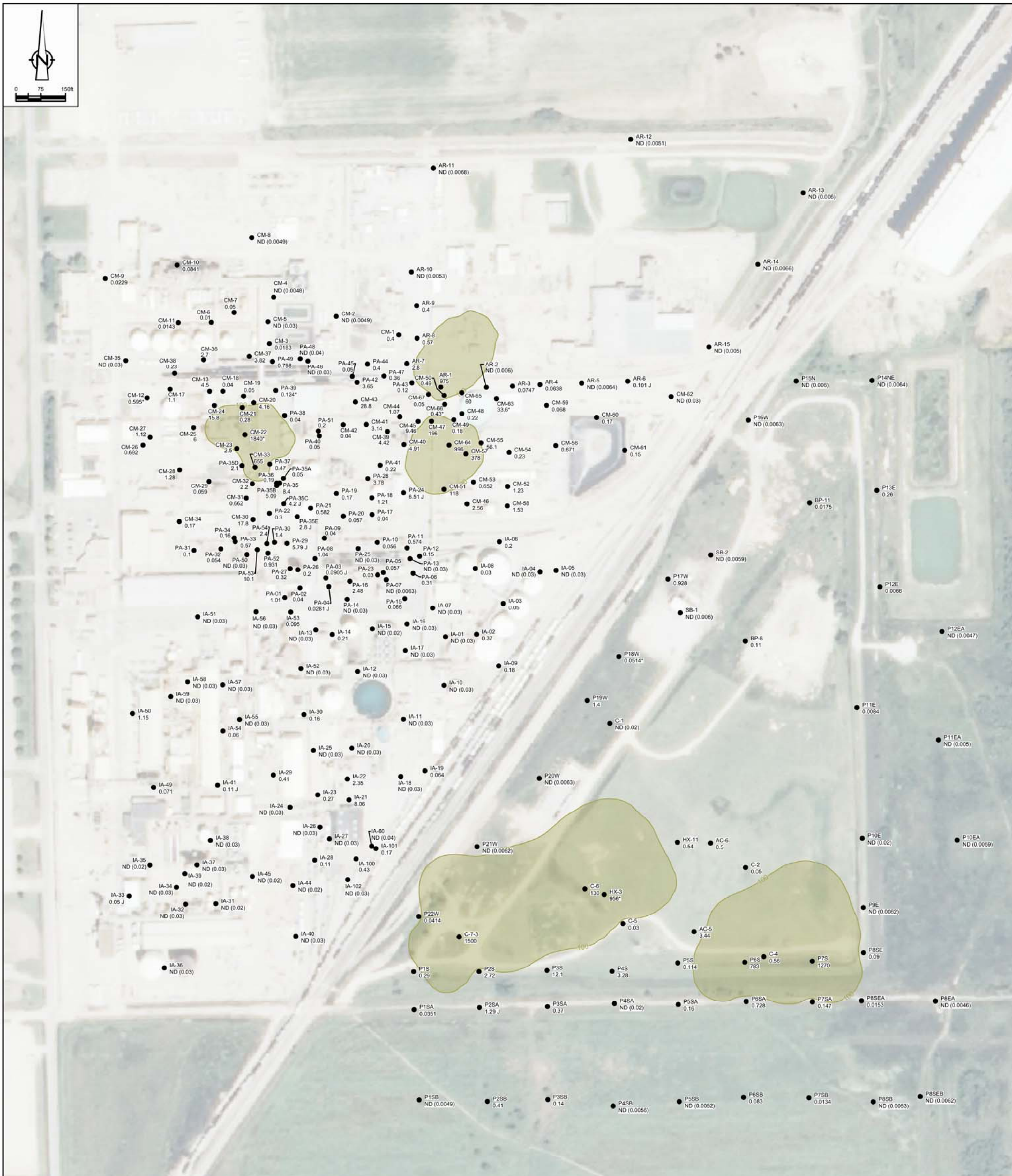
APPENDIX I

SOIL AND GROUNDWATER ISOCONCENTRATION MAPS SHOWING SAMPLE LOCATIONS AND ANALYTICAL RESULTS



LEGEND:

- 100 PERACHLOROETHENE ISOCONCENTRATION CONTOUR IN mg/kg
- CM-1 / 0.4 ● SOIL SAMPLE LOCATION AND IDENTIFIER / SOIL SAMPLE RESULT
- ND NOT DETECTED
- * AVERAGE VALUE OF CO-LOCATED RESULTS
- ^ ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

CHEMICAL NAME	INDUSTRIAL SOIL	UNITS
PERCHLOROETHYLENE	110	mg/kg

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

Nº	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

PERCHLOROETHENLYENE ISOCONCENTRATION CONTOURS IN SOIL AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOUR

OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:	
B. CLEGG	S. SOUTTER	3/15/13	
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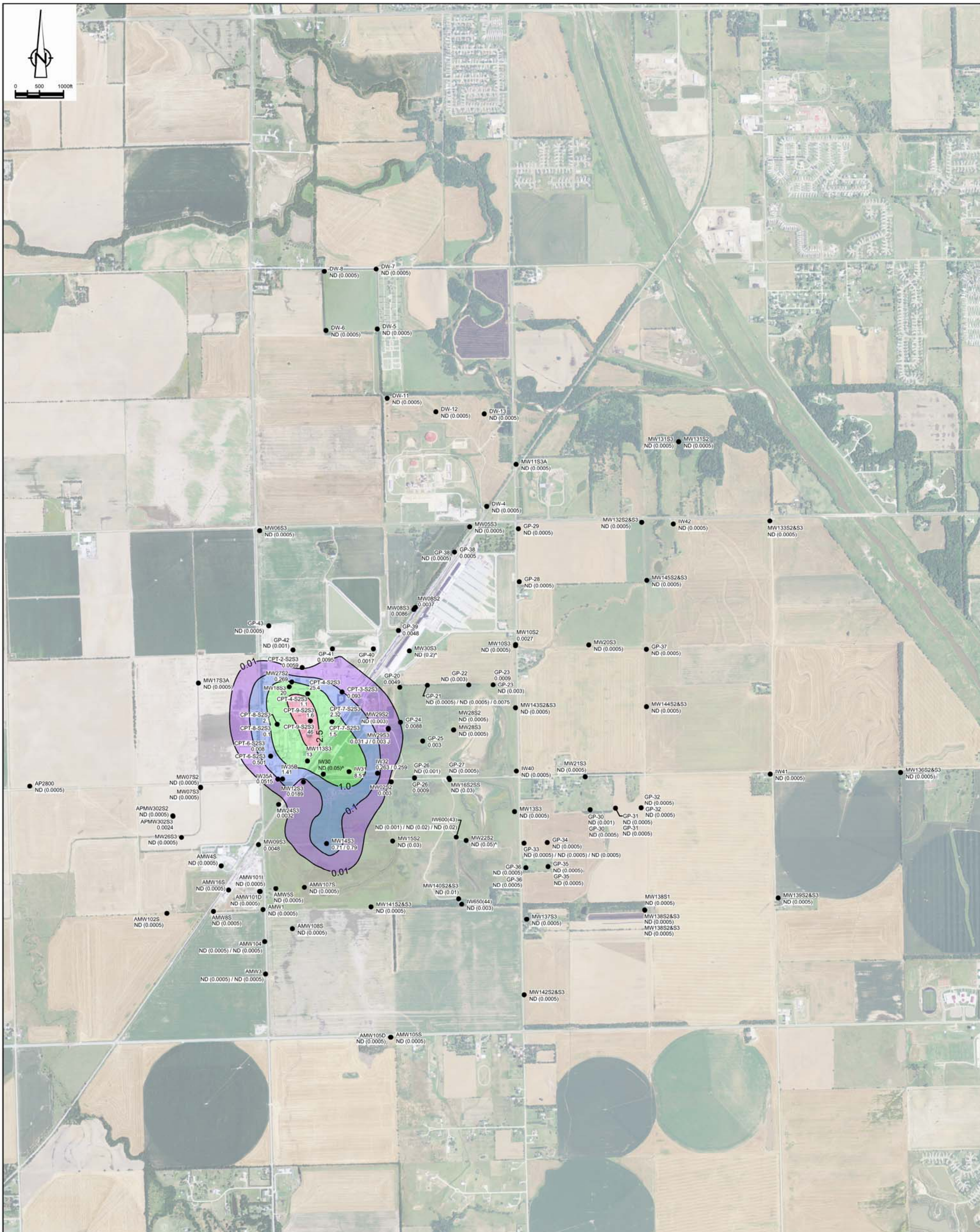

LEGEND:

0.001 PERCHLOROETHYLENE ISOCONCENTRATION CONTOUR IN mg/L

AMW1 ● MONITORING WELL LOCATION AND IDENTIFIER
ND (0.00005) GROUNDWATER SAMPLE RESULT mg/L

ND (0.00005) NOT DETECTED

* AVERAGE VALUE OF CO-LOCATED RESULTS

^ ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

GROUNDWATER CRITERIA			
CHEMICAL NAME	MCL	TAP WATER	UNITS
PERCHLOROETHYLENE	0.005	0.0097	mg/L

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

NOTES:

1- ISOCONCENTRATION CONTOURS WERE GENERATED BASED ON THE MAY 2012 GROUNDWATER SAMPLING EVENT, THE MAY 2012 CPT GROUNDWATER SAMPLING, AND THE SEPTEMBER 2012 GEOPROBE SAMPLING REPRESENTATIVE OF THE S2/S3 AQUIFER USING SURFER 7, LOG10 TRANSFORMED DATA, HALF THE MEDIAN LIMIT FOR NON-DETECTION VALUES, LINEAR 1:1 VARIOGRAM WITH ANISOTROPY OF 1.5 AT 135°, AND LINEAR DRIFT.

2- RESIDENTIAL WELL DATA INCLUDED IN ISOCONCENTRATION CONTOURS BUT POINT CONCENTRATIONS NOT SHOWN ON FIGURE

№	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

PERCHLOROTHENLYENE ISOCONCENTRATION CONTOURS IN S2/S3 GROUNDWATER AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOURS

OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:	
B. CLEGG	S. SOUTTER	3/15/13	
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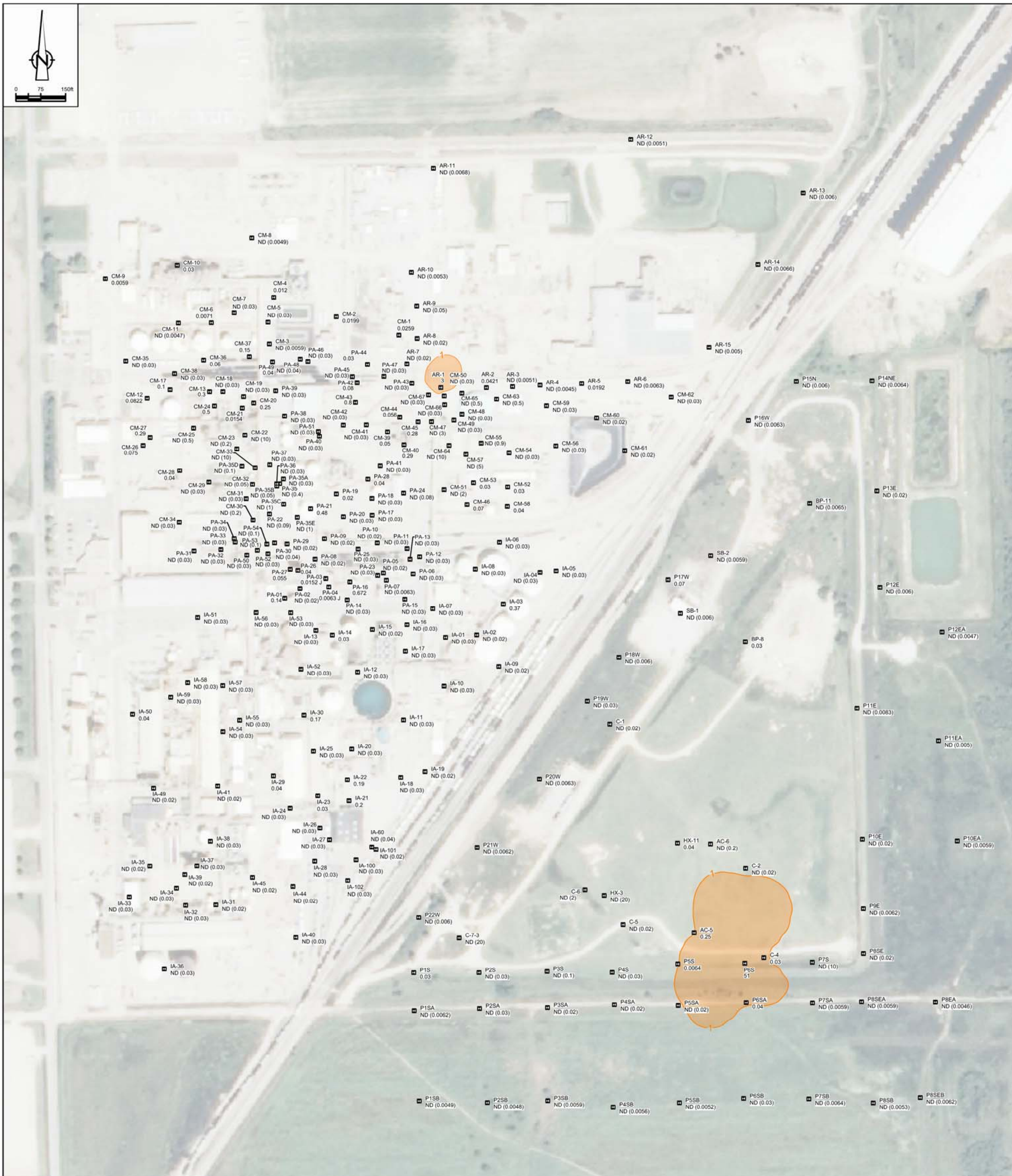

LEGEND:

TRICHLOROETHENE ISOCONCENTRATION CONTOUR IN mg/kg

AR-1 0.0259 — SOIL SAMPLE LOCATION AND IDENTIFIER / SOIL SAMPLE RESULT

ND — NOT DETECTED

★ — AVERAGE VALUE OF CO-LOCATED RESULTS

^ — ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

CHEMICAL NAME	INDUSTRIAL SOIL	UNITS
TRICHLOROETHENE	6.4	mg/kg

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

Nº	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

TRICHLOROETHENE ISOCONCENTRATION CONTOURS IN SOIL AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOUR

OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

CONESTOGA-ROVERS & ASSOCIATES

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Project Manager:	Reviewed By:	Date:	
B. CLEGG	S. SOUTTER	3/15/13	
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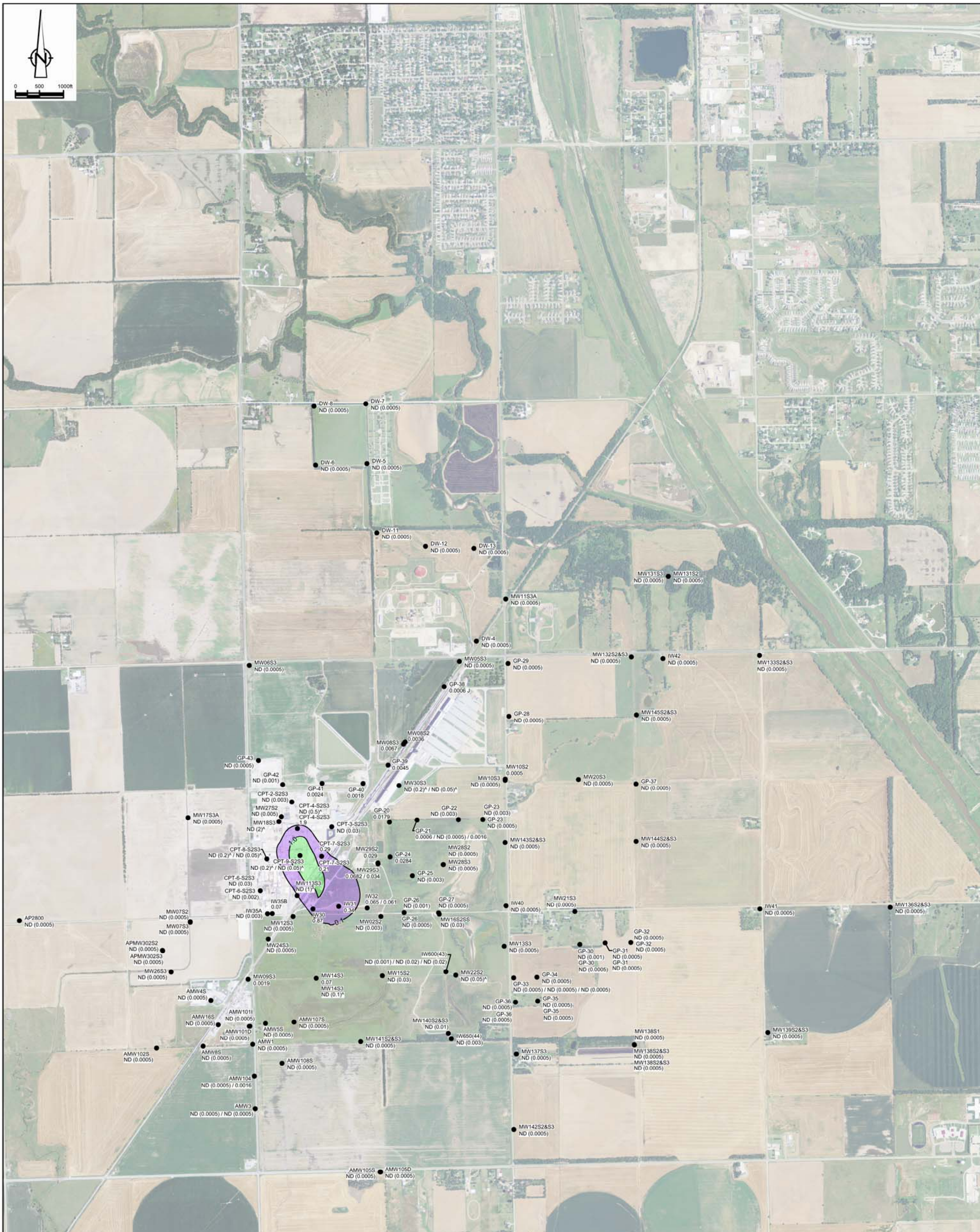

LEGEND:

0.01 TRICHLOROETHENE ISOCONCENTRATION CONTOUR IN mg/L

AMW1 ND (0.00005) ● MONITORING WELL LOCATION AND IDENTIFIER GROUNDWATER SAMPLE RESULT mg/L

ND (0.00005) NOT DETECTED

* AVERAGE VALUE OF CO-LOCATED RESULTS

^ ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

GROUNDWATER CRITERIA			
CHEMICAL NAME	MCL	TAP WATER	UNITS
TRICHLOROETHENE	0.005	0.00044	mg/L

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

NOTES:

1- ISCONCENTRATION CONTOURS WERE GENERATED BASED ON THE MAY 2012 GROUNDWATER SAMPLING EVENT, THE MAY 2012 CPT GROUNDWATER SAMPLING, AND THE SEPTEMBER 2012 GEOPROBE SAMPLING REPRESENTATIVE OF THE S2/S3 AQUIFER USING SURFER 7, LOG10 TRANSFORMED DATA, HALF THE MEDIAN LIMIT FOR NON-DETECTION VALUES, LINEAR 1:1 VARIOGRAM WITH ANISOTROPY OF 1.5 AT 135°, AND LINEAR DRIFT.

2- RESIDENTIAL WELL DATA INCLUDED IN ISONCENTRATION CONTOURS BUT POINT CONCENTRATIONS NOT SHOWN ON FIGURE.

Nº	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

TRICHLOROETHENE ISOCONCENTRATION CONTOURS IN S2/S3 GROUNDWATER AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOURS

OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:	
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54046-D21111(036)GN-CO083 MAR 15/2013

LEGEND:

0.01 VINYL CHLORIDE ISOCONCENTRATION CONTOUR IN mg/kg

AR-1 0.0259 SOIL SAMPLE LOCATION AND IDENTIFIER / SOIL SAMPLE RESULT

ND NOT DETECTED

★ AVERAGE VALUE OF CO-LOCATED RESULTS

^ ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

CHEMICAL NAME	INDUSTRIAL SOIL	UNITS
VINYL CHLORIDE	1.7	mg/kg

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

Nº	Revision	Date	Initial

SCALE VERIFICATION

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Approved

VINYL CHLORIDE ISOCONCENTRATION CONTOURS IN SOIL AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOUR

OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:	
B. CLEGG	S. SOUTTER	3/15/13	
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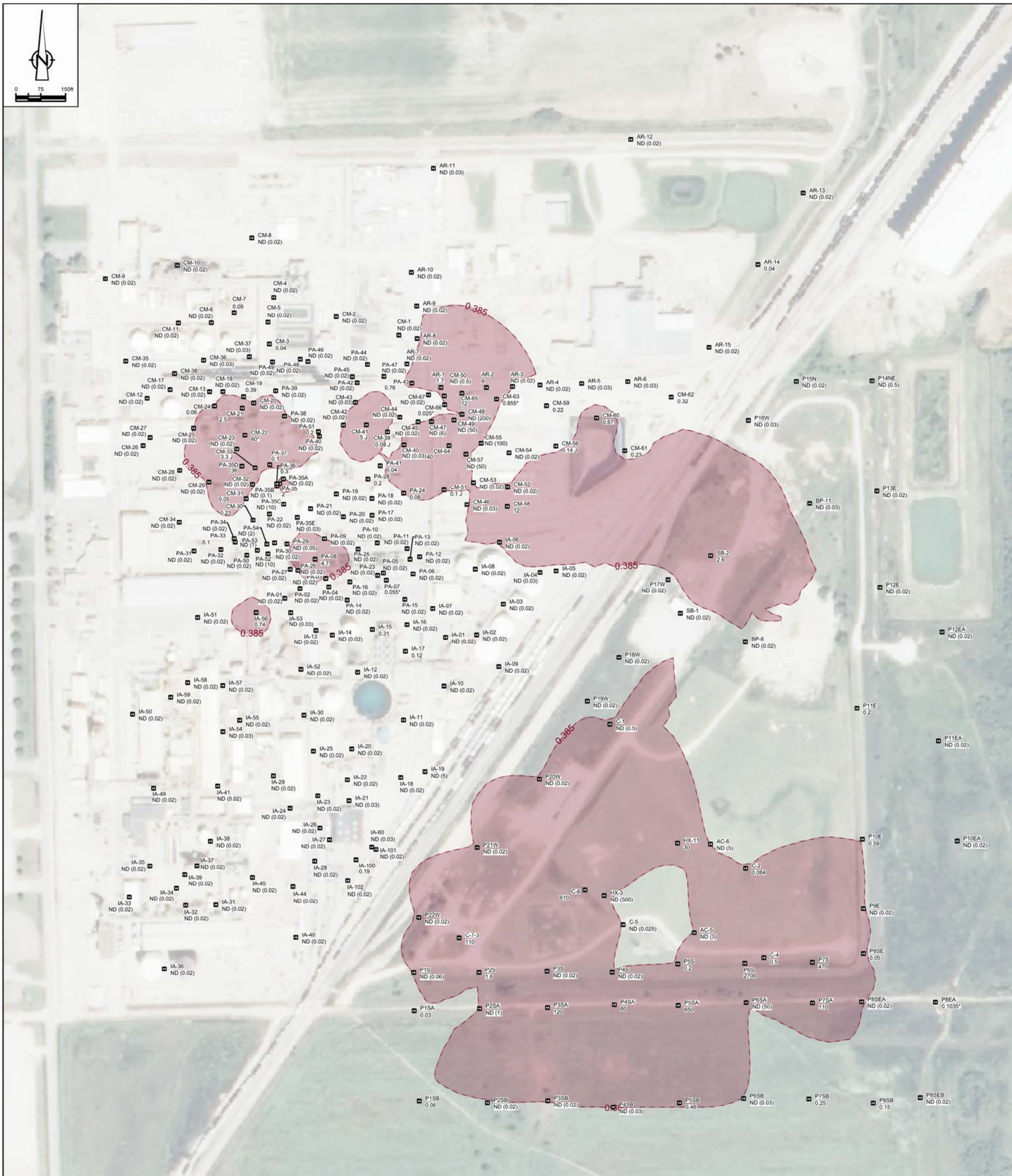

LEGEND:

0.385 HEXACHLOROBENZENE ISOCONCENTRATION CONTOUR IN mg/kg

CM-1 ND (0.02) SOIL SAMPLE LOCATION AND IDENTIFIER SOIL SAMPLE RESULT

ND NOT DETECTED

* AVERAGE VALUE OF CO-LOCATED RESULTS

^ ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

CHEMICAL NAME	INDUSTRIAL SOIL	UNITS
HEXACHLOROBENZENE	1.1	mg/kg

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

No	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

HEXACHLOROBENZENE ISOCONCENTRATION CONTOURS IN SOIL AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOUR

OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:	
B. CLEGG	S. SOUTTER	3/15/13	
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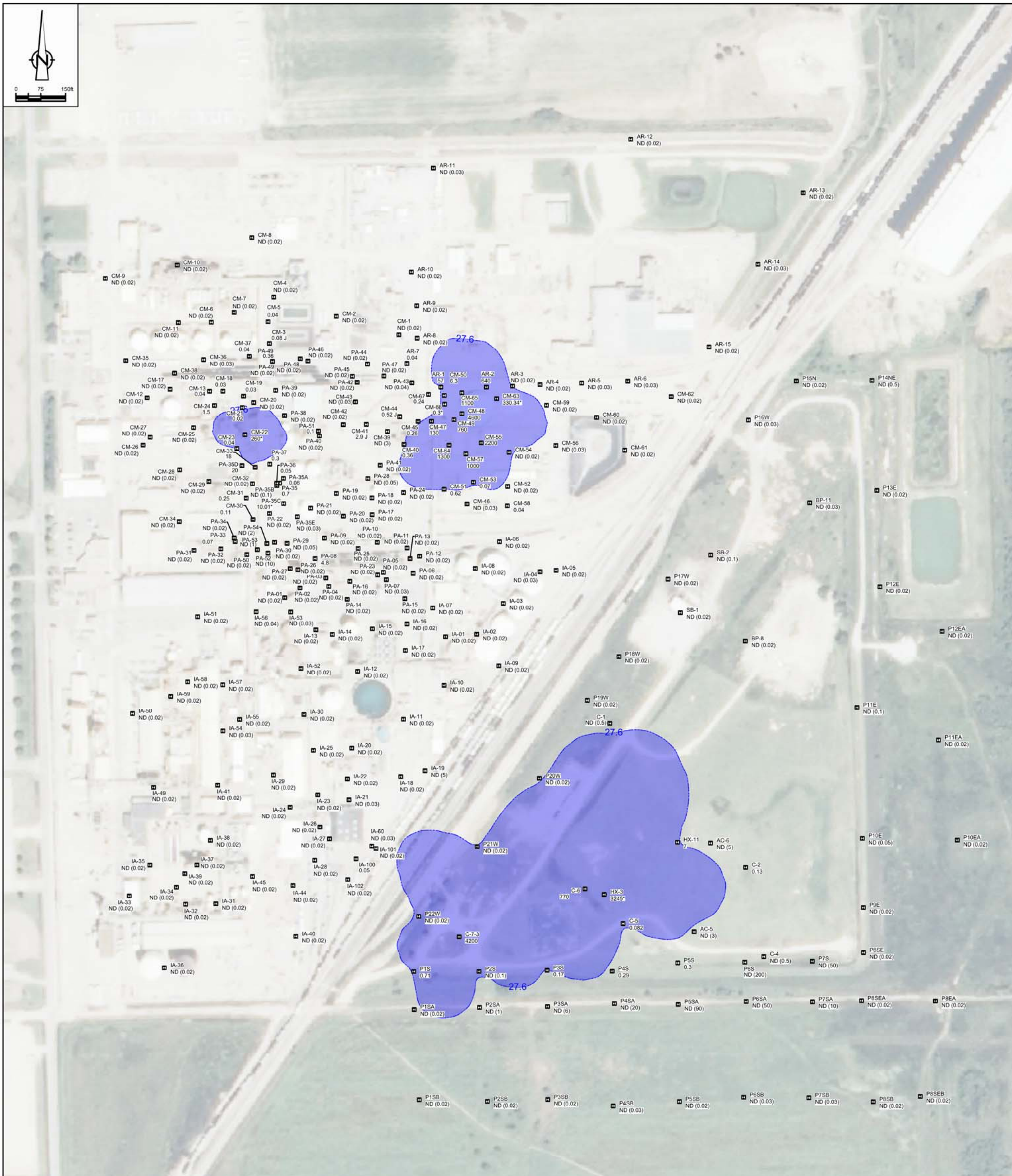

LEGEND:

27.6 HEXACHLOROBUTADIENE ISOCONCENTRATION CONTOUR IN mg/kg

CM-1 ND (0.02) SOIL SAMPLE LOCATION AND IDENTIFIER SOIL SAMPLE RESULT

ND NOT DETECTED

* AVERAGE VALUE OF CO-LOCATED RESULTS

^ ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

CHEMICAL NAME	INDUSTRIAL SOIL	UNITS
HEXACHLOROBUTADIENE	22	mg/kg

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

No	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

HEXACHLOROBUTADIENE ISOCONCENTRATION CONTOURS IN SOIL AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOUR

OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:
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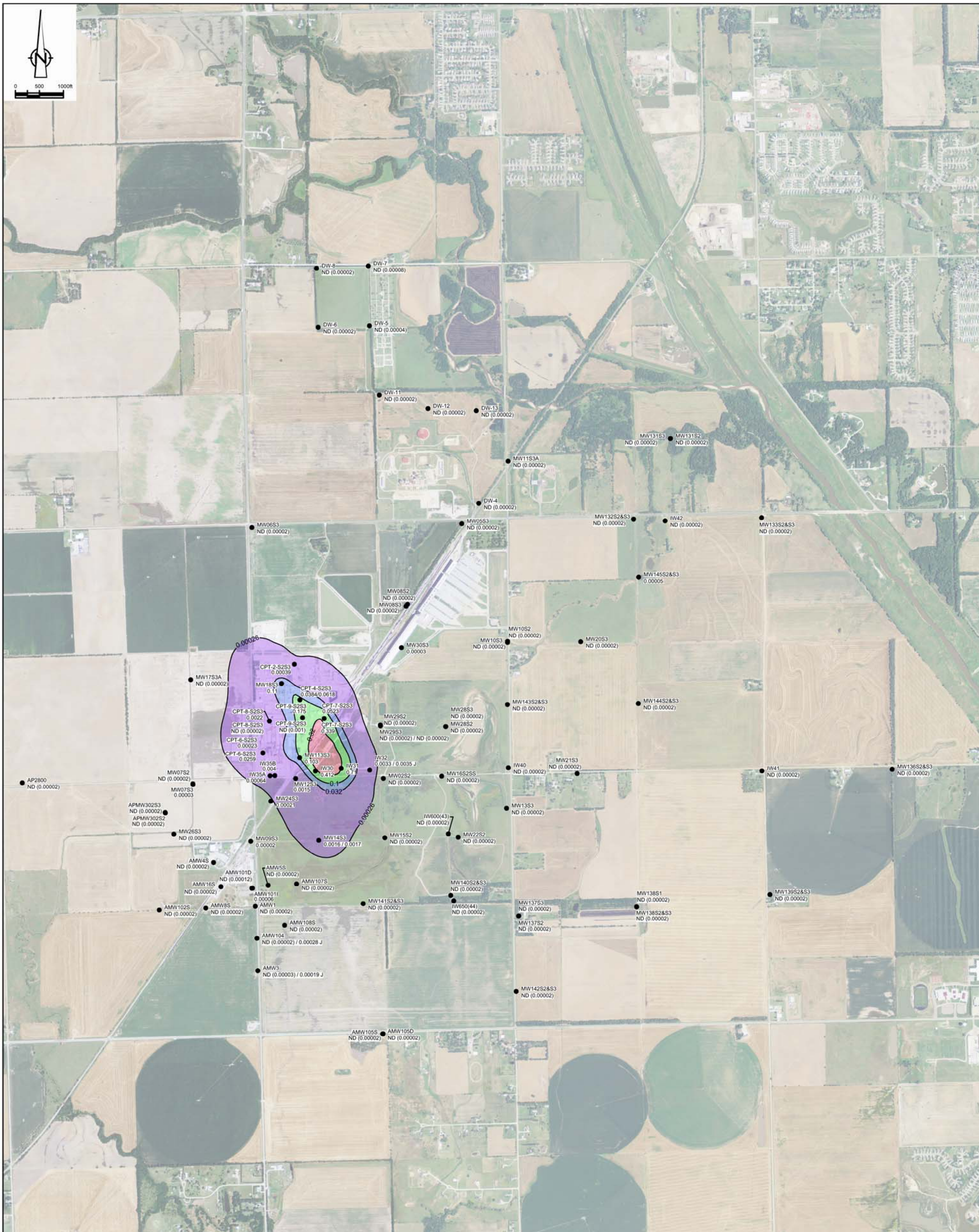

LEGEND:

0.00026 HEXACHLOROBUTADIENE ISOCONCENTRATION CONTOUR IN mg/L

AMW1 ● MONITORING WELL LOCATION AND IDENTIFIER
ND (0.00005) GROUNDWATER SAMPLE RESULT mg/L

ND (0.00005) NOT DETECTED

* AVERAGE VALUE OF CO-LOCATED RESULTS

^ ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

GROUNDWATER CRITERIA			
CHEMICAL NAME	MCL	TAP WATER	UNITS
HEXACHLOROBUTADIENE	--	0.00026	mg/L

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

NOTES:

1- ISCONCENTRATION CONTOURS WERE GENERATED BASED ON THE MAY 2012 GROUNDWATER SAMPLING EVENT, THE MAY 2012 CPT GROUNDWATER SAMPLING, AND THE SEPTEMBER 2012 GEOPROBE SAMPLING REPRESENTATIVE OF THE S2/S3 AQUIFER USING SURFER 7, LOG10 TRANSFORMED DATA, HALF THE MEDIAN LIMIT FOR NON-DETECTION VALUES, LINEAR 1:1 VARIOGRAM WITH ANISOTROPY OF 1.5 AT 135°, AND LINEAR DRIFT.

2- RESIDENTIAL WELL DATA INCLUDED IN ISONCENTRATION CONTOURS BUT POINT CONCENTRATIONS NOT SHOWN ON FIGURE.

Nº	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

HEXACHLOROBUTADIENE ISOCONCENTRATION CONTOURS IN S2/S3 GROUNDWATER AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOURS

OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:	
B. CLEGG	S. SOUTTER	3/15/13	
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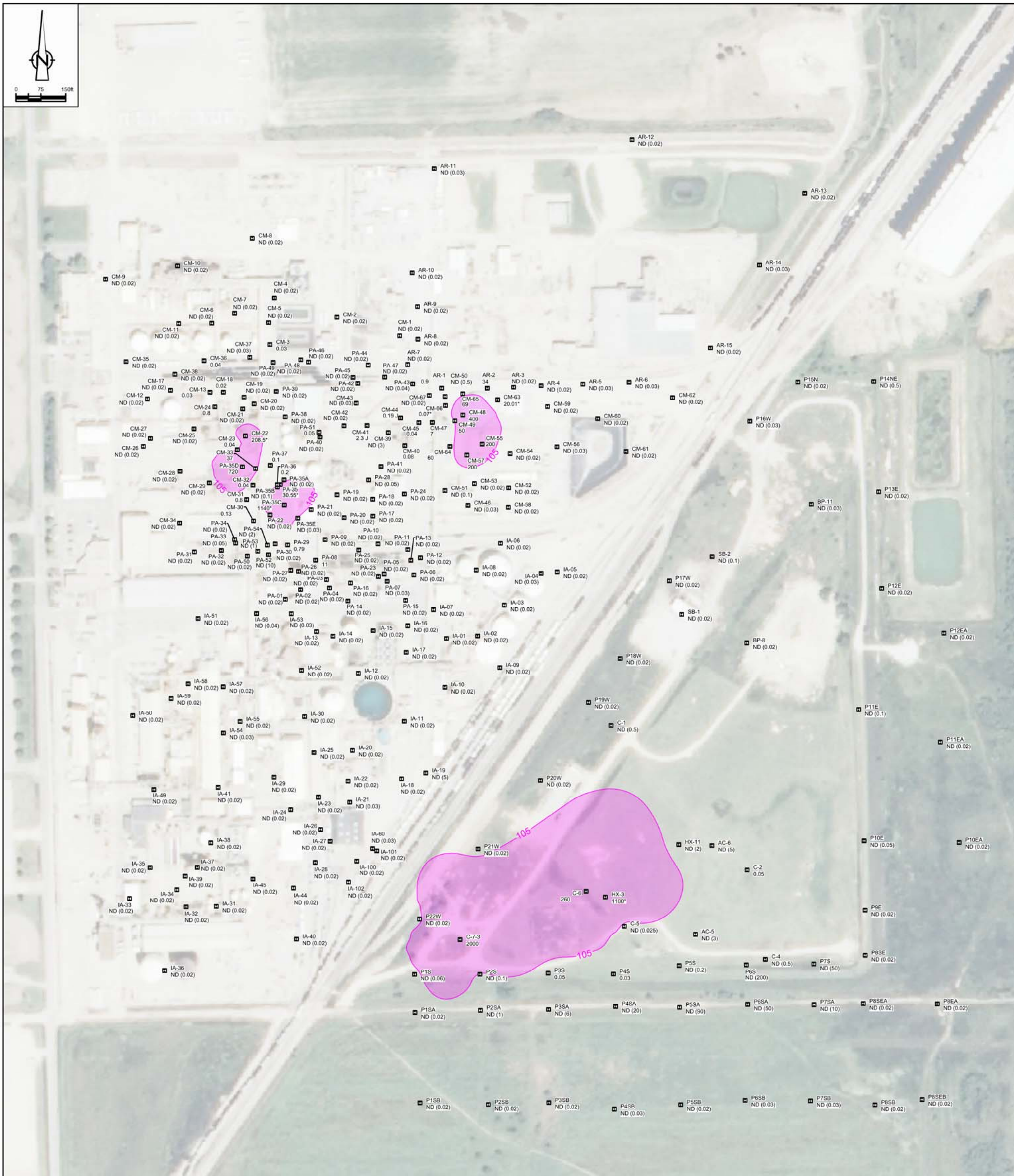


LEGEND:

105 HEXACHLOROETHANE ISOCONCENTRATION CONTOUR IN mg/kg

CM-1 ND (0.02) SOIL SAMPLE LOCATION AND IDENTIFIER SOIL SAMPLE RESULT

ND NOT DETECTED

* AVERAGE VALUE OF CO-LOCATED RESULTS

^ ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

CHEMICAL NAME	INDUSTRIAL SOIL	UNITS
HEXACHLOROETHANE	43	mg/kg

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

Nº	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

HEXACHLOROETHANE ISOCONCENTRATION CONTOURS IN SOIL AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOUR

OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

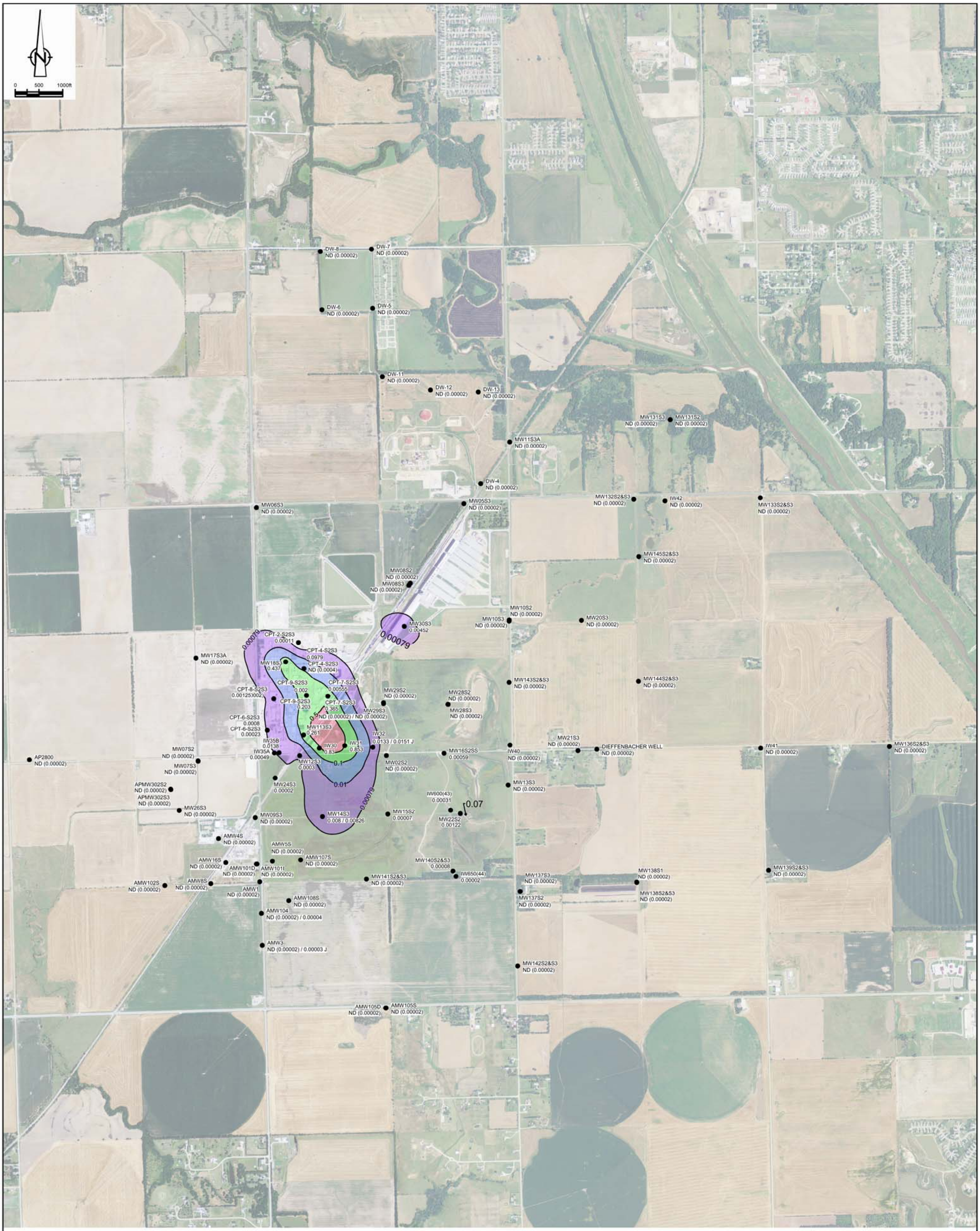
CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:
B. CLEGG	S. SOUTTER	3/15/13

Scale:	Project Nº:	Report Nº:	Drawing Nº:
1:150	54046-D21111	036	figure I 9

54046-D21111(036)GN-CO100 MAR 15/2013



LEGEND:

0.00079 HEXACHLOROETHANE ISOCONCENTRATION CONTOUR IN mg/L

AMW1 ND (0.00002) ● MONITORING WELL LOCATION AND IDENTIFIER GROUNDWATER SAMPLE RESULT mg/L

ND (0.00002) NOT DETECTED

* AVERAGE VALUE OF CO-LOCATED RESULTS

^ ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

GROUNDWATER CRITERIA			
CHEMICAL NAME	MCL	TAP WATER	UNITS
HEXACHLOROETHANE	--	0.00079	mg/L

NOTES:

1- ISOCONCENTRATION CONTOURS WERE GENERATED BASED ON THE MAY 2012 GROUNDWATER SAMPLING EVENT, THE MAY 2012 CPT GROUNDWATER SAMPLING, AND THE SEPTEMBER 2012 GEOPROBE SAMPLING REPRESENTATIVE OF THE S2/S3 AQUIFER USING SURFER 7, LOG10 TRANSFORMED DATA, HALF THE MEDIAN LIMIT FOR NON-DETECTION VALUES, LINEAR 1:1 VARIOGRAM WITH ANISOTROPY OF 1.5 AT 135°, AND LINEAR DRIFT.

2- RESIDENTIAL WELL DATA INCLUDED IN ISOCENTRATION CONTOURS BUT POINT CONCENTRATIONS NOT SHOWN ON FIGURE.

№	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

HEXACHLOROETHANE ISOCONCENTRATION CONTOURS IN S2/S3 GROUNDWATER AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOURS

OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:	
B. CLEGG	S. SOUTTER	3/15/13	
Scale:	Project №:	Report №:	Drawing №:
#####	54046-D21111	036	figure 10

54046-D21111(036)GN-CO079 MAR 15/2013

LEGEND:

10 — 1,1,1-TRICHLOROETHANE ISOCONCENTRATION CONTOUR IN MG/KG

CM-1 / 0.0813 — SOIL SAMPLE LOCATION AND IDENTIFIER / SOIL SAMPLE RESULT

ND — NOT DETECTED

* — AVERAGE VALUE OF CO-LOCATED RESULTS

^ — ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

CHEMICAL NAME	INDUSTRIAL SOIL	UNITS
1,1,1-TRICHLOROETHANE	38,000	mg/kg

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

Nº	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

1,1,1-TRICHLOROETHANE ISOCONCENTRATION CONTOURS IN SOIL AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOUR

OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

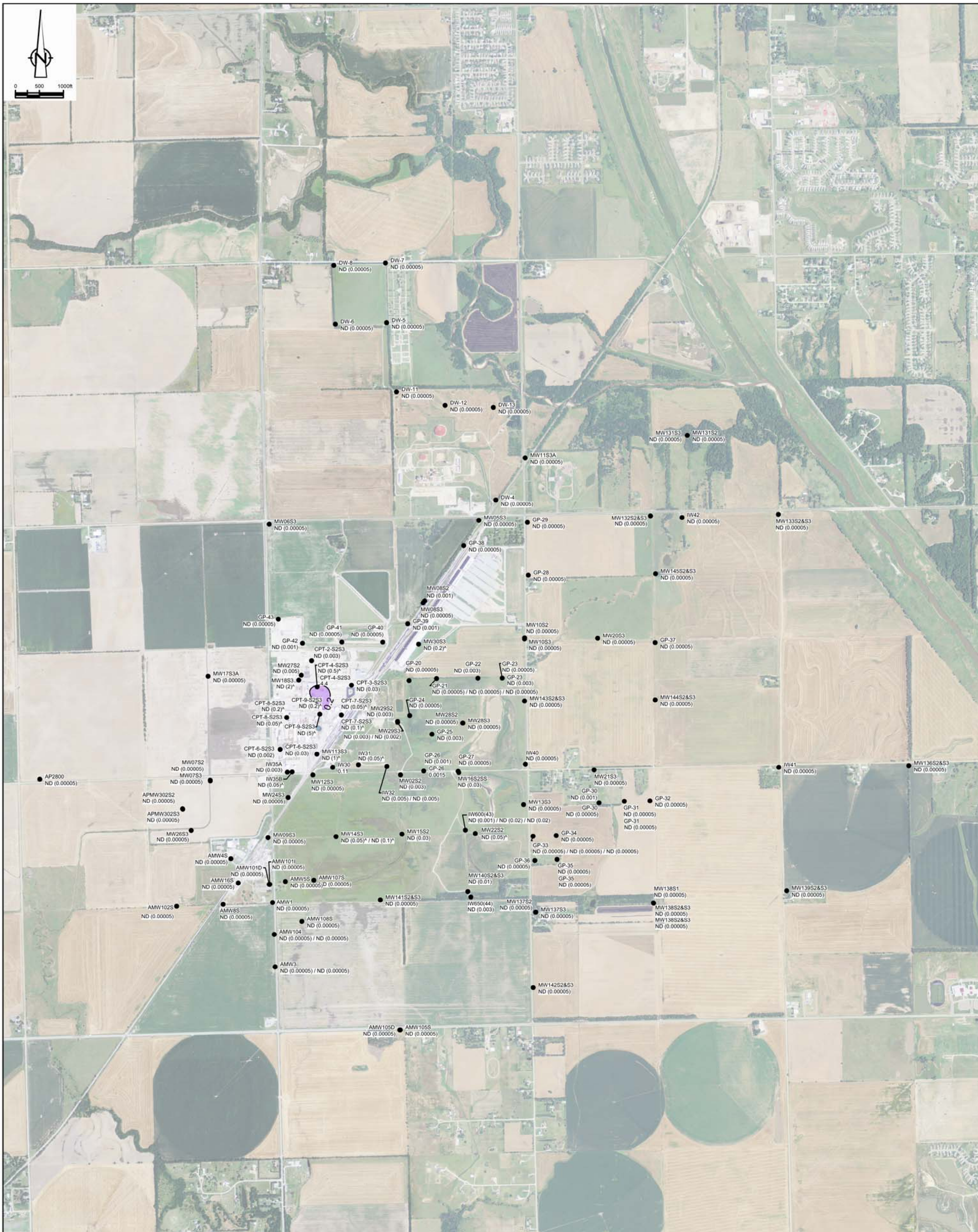
CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:
B. CLEGG	S. SOUTTER	3/15/13

Scale:	Project Nº:	Report Nº:	Drawing Nº:
1:150	54046-D21111	036	figure I 11

54046-D21111(036)GN-CO084 MAR 15/2013



LEGEND:

0.2 — 1,1,1-TRICHLOROETHANE ISOCONCENTRATION CONTOUR IN mg/L

AMW1 ND (0.00005) ● — MONITORING WELL LOCATION AND IDENTIFIER GROUNDWATER SAMPLE RESULT mg/L

ND (0.00005) — NOT DETECTED

* — AVERAGE VALUE OF CO-LOCATED RESULTS

^ — ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

GROUNDWATER CRITERIA			
CHEMICAL NAME	MCL	TAP WATER	UNITS
1,1,1-TRICHLOROETHANE	0.2	7.5	mg/L

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

NOTES:

1- ISCONCENTRATION CONTOURS WERE GENERATED BASED ON THE MAY 2012 GROUNDWATER SAMPLING EVENT, THE MAY 2012 CPT GROUNDWATER SAMPLING, AND THE SEPTEMBER 2012 GEOPROBE SAMPLING REPRESENTATIVE OF THE S2/S3 AQUIFER USING SURFER 7, LOG10 TRANSFORMED DATA, HALF THE MEDIAN LIMIT FOR NON-DETECTION VALUES, LINEAR 1:1 VARIOGRAM WITH ANISOTROPY OF 1.5 AT 135°, AND LINEAR DRIFT.

2- RESIDENTIAL WELL DATA INCLUDED IN ISONCENTRATION CONTOURS BUT POINT CONCENTRATIONS NOT SHOWN ON FIGURE.

Nº	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

1,1,1-TRICHLOROETHANE ISOCONCENTRATION CONTOURS IN S2/S3 GROUNDWATER AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOURS

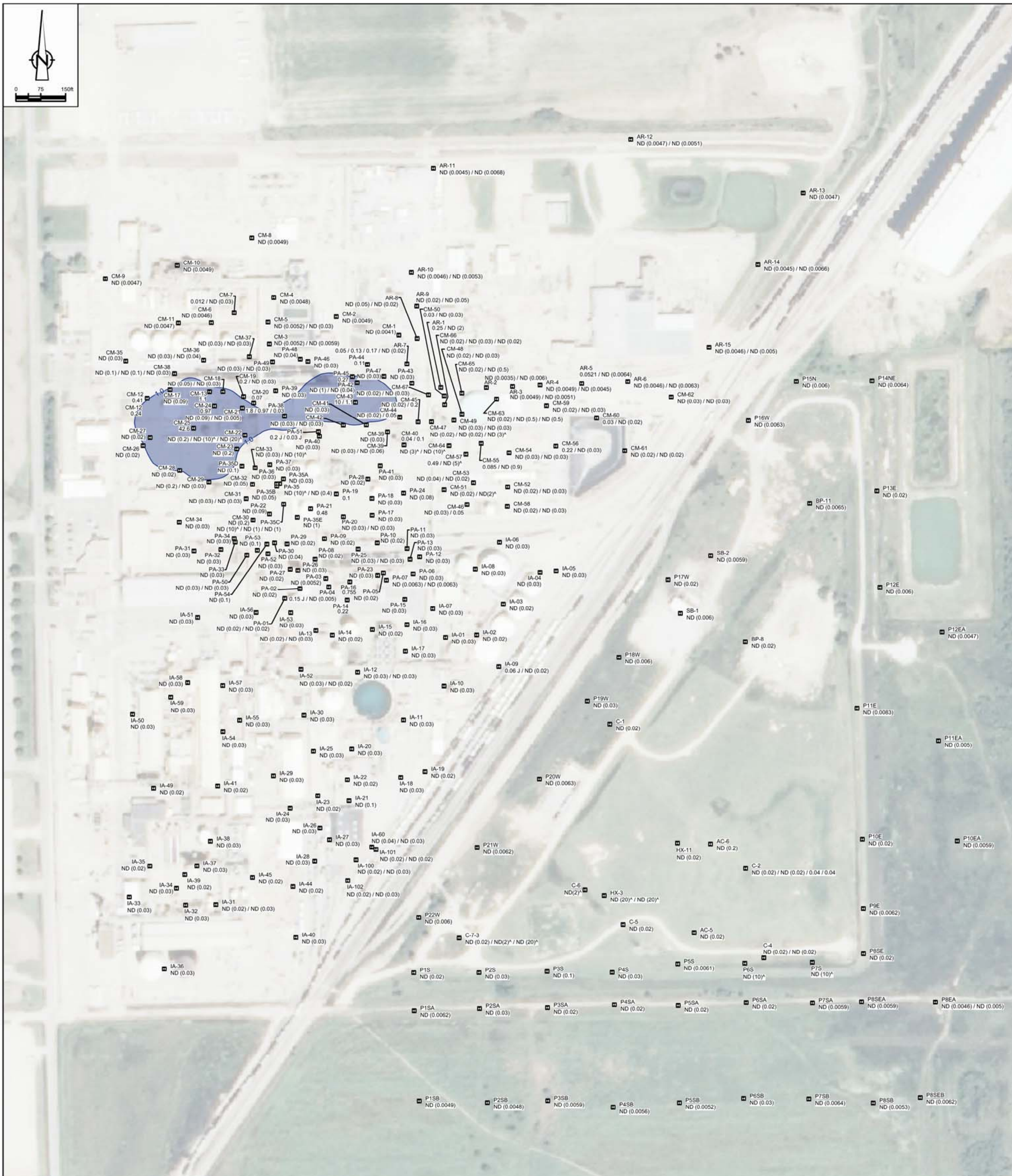
OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:	
B. CLEGG	S. SOUTTER	3/15/13	
Scale:	Project Nº:	Report Nº:	Drawing Nº:
#####	54046-D21111	036	figure I 12

54046-D21111(036)GN-CO063 MAR 15/2013



LEGEND:

1.0 1,2-DICHLOROETHANE ISOCONCENTRATION CONTOUR IN MG/KG

CM-1 ND (0.0041) SOIL SAMPLE LOCATION AND IDENTIFIER SOIL SAMPLE RESULT

ND NOT DETECTED

* AVERAGE VALUE OF CO-LOCATED RESULTS

^ ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

CHEMICAL NAME	INDUSTRIAL SOIL	UNITS
1,2-DICHLOROETHANE	2.2	mg/kg

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

No	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

1,2-DICHLOROETHANE ISOCONCENTRATION CONTOURS IN SOIL AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOUR

OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

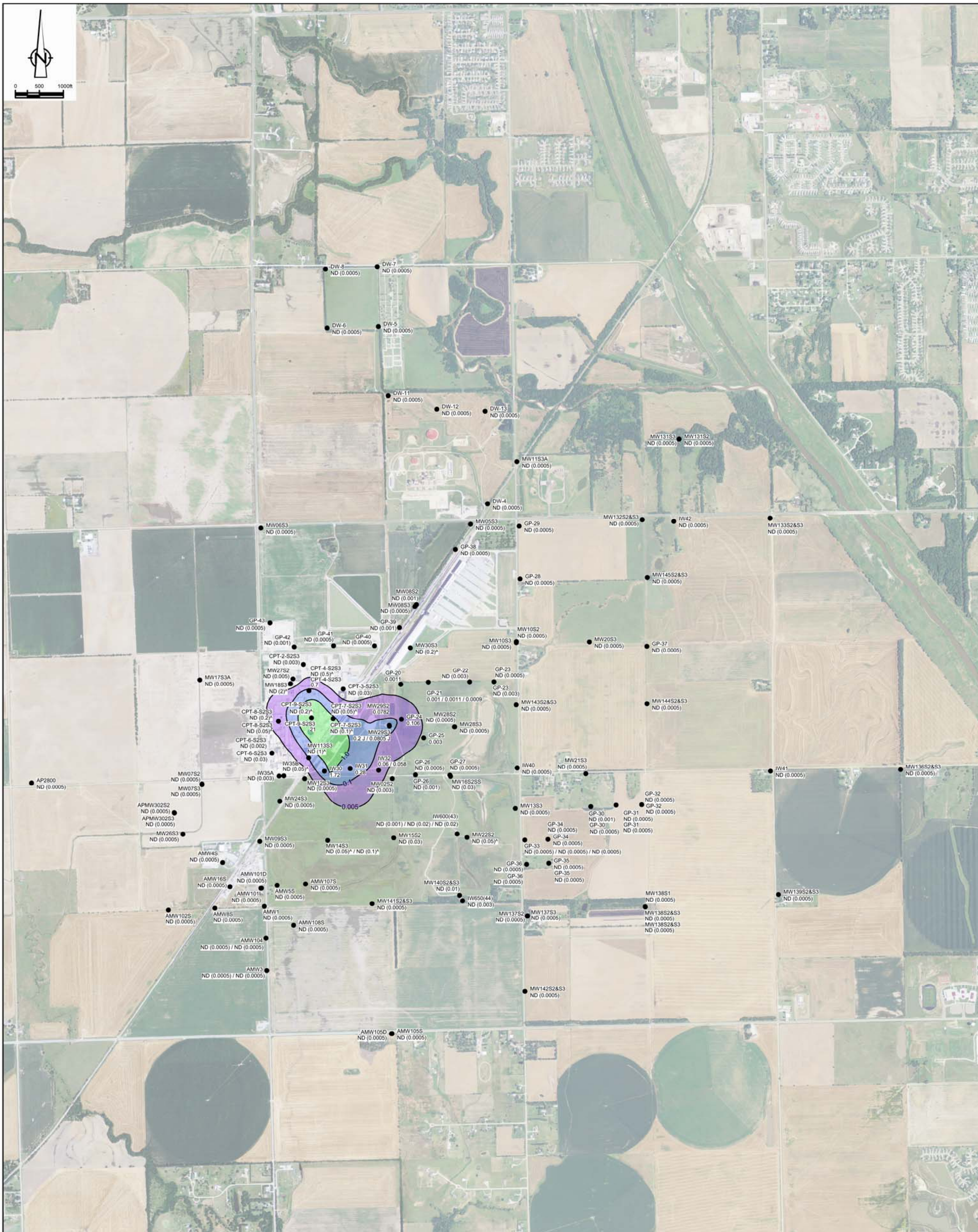
CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:
B. CLEGG	S. SOUTTER	3/15/13

Scale:	Project No:	Report No:	Drawing No:
1:150	54046-D21111	036	figure I 13

54046-D21111(036)GN-CO087 MAR 15/2013



LEGEND:

0.005 1,2-DICHLOROETHANE ISOCONCENTRATION CONTOUR IN mg/L

AMW1
ND (0.00005) ● MONITORING WELL LOCATION AND IDENTIFIER
GROUNDWATER SAMPLE RESULT mg/L

ND (0.00005) NOT DETECTED

* AVERAGE VALUE OF CO-LOCATED RESULTS

^ ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

GROUNDWATER CRITERIA			
CHEMICAL NAME	MCL	TAP WATER	UNITS
1,2-DICHLOROETHANE	0.005	0.00015	mg/L

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

NOTES:

1- ISCONCENTRATION CONTOURS WERE GENERATED BASED ON THE MAY 2012 GROUNDWATER SAMPLING EVENT, THE MAY 2012 CPT GROUNDWATER SAMPLING, AND THE SEPTEMBER 2012 GEOPROBE SAMPLING REPRESENTATIVE OF THE S2/S3 AQUIFER USING SURFER 7, LOG10 TRANSFORMED DATA, HALF THE MEDIAN LIMIT FOR NON-DETECTION VALUES, LINEAR 1:1 VARIOGRAM WITH ANISOTROPY OF 1.5 AT 135°, AND LINEAR DRIFT.

2- RESIDENTIAL WELL DATA INCLUDED IN ISONCENTRATION CONTOURS BUT POINT CONCENTRATIONS NOT SHOWN ON FIGURE.

Nº	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

1,2-DICHLOROETHANE ISOCONCENTRATION CONTOURS IN S2/S3 GROUNDWATER AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOURS

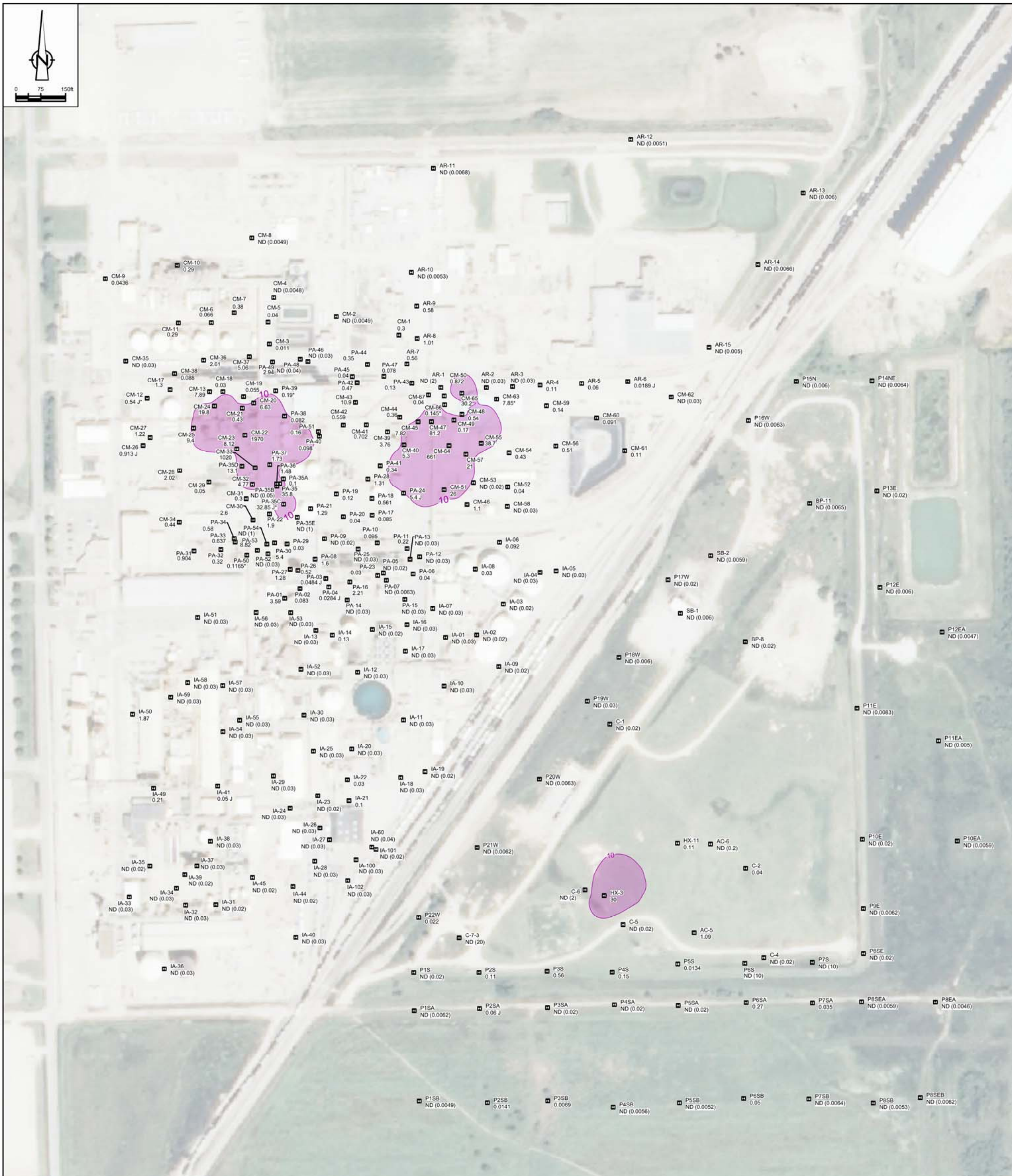
OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:	
B. CLEGG	S. SOUTTER	3/15/13	
Scale: #####	Project Nº: 54046-D21111	Report Nº: 036	Drawing Nº: figure I 14

54046-D21111(036)GN-CO064 MAR 15/2013



LEGEND:

10 — CARBON TETRACHLORIDE ISOCONCENTRATION CONTOUR IN mg/kg

CM-1 0.3 — SOIL SAMPLE LOCATION AND IDENTIFIER / SOIL SAMPLE RESULT

ND — NOT DETECTED

* — AVERAGE VALUE OF CO-LOCATED RESULTS

^ — ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

CHEMICAL NAME	INDUSTRIAL SOIL	UNITS
CARBON TETRACHLORIDE	3	mg/kg

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

Nº	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

CARBON TETRACHLORIDE ISOCONCENTRATION CONTOURS IN SOIL AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOUR

OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

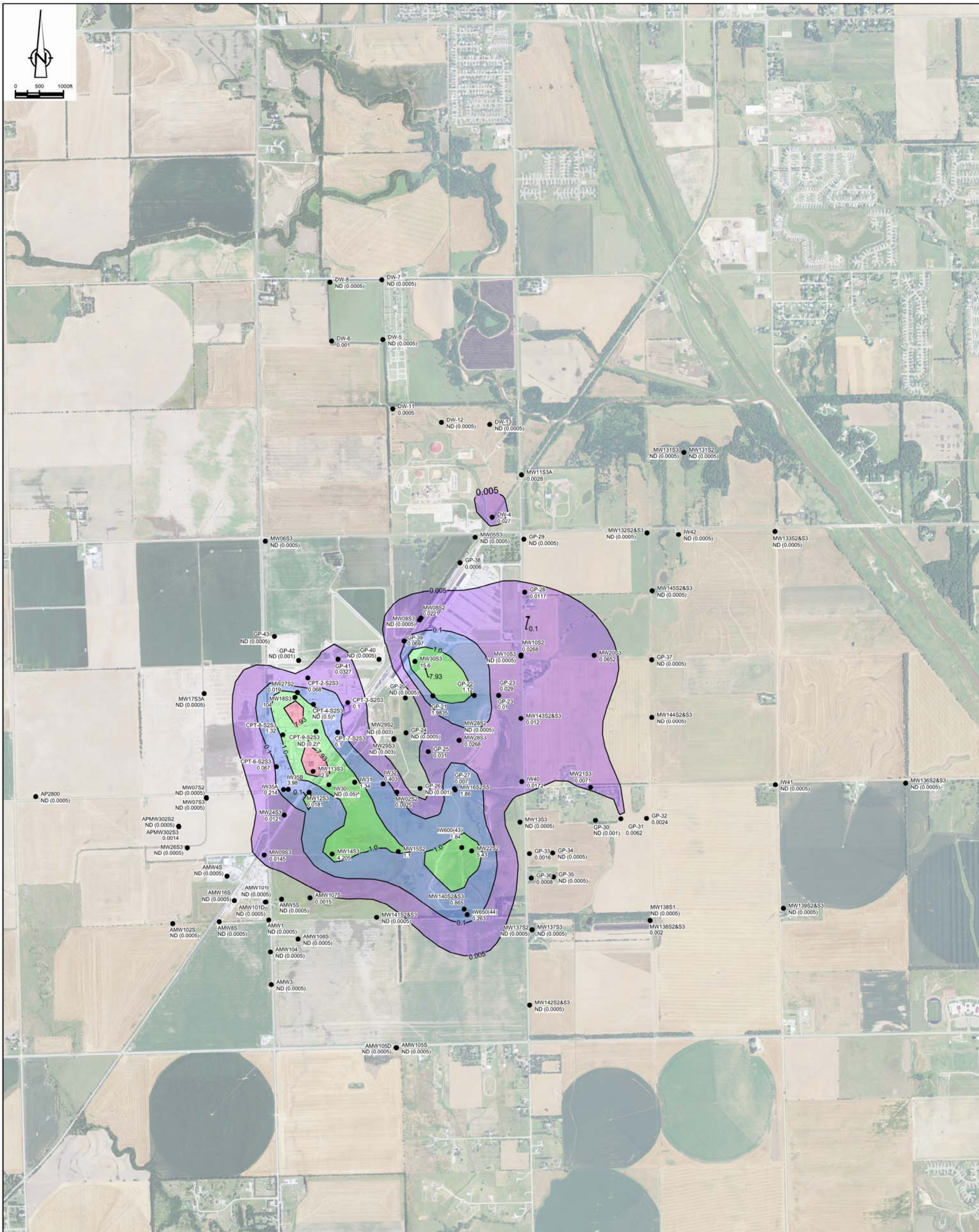
CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:
B. CLEGG	S. SOUTTER	3/15/13

Scale:	Project Nº:	Report Nº:	Drawing Nº:
1:150	54046-D21111	036	figure I 15

54046-D21111(036)GN-CO095 MAR 15/2013



LEGEND:

0.005 CARBON TETRACHLORIDE ISOCONCENTRATION CONTOUR IN mg/L

AMW1 ND (0.00005) ● MONITORING WELL LOCATION AND IDENTIFIER GROUNDWATER SAMPLE RESULT mg/L

ND (0.00005) NOT DETECTED

* AVERAGE VALUE OF CO-LOCATED RESULTS

^ ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

GROUNDWATER CRITERIA

CHEMICAL NAME	MCL	TAP WATER	UNITS
CARBON TETRACHLORIDE	0.005	0.00039	mg/L

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

NOTES:

1- ISOCONCENTRATION CONTOURS WERE GENERATED BASED ON THE MAY 2012 GROUNDWATER SAMPLING EVENT, THE MAY 2012 CPT GROUNDWATER SAMPLING, AND THE SEPTEMBER 2012 GEOPROBE SAMPLING REPRESENTATIVE OF THE S2/S3 AQUIFER USING SURFER 7, LOG10 TRANSFORMED DATA, HALF THE MEDIAN LIMIT FOR NON-DETECTION VALUES, LINEAR 1:1 VARIOGRAM WITH ANISOTROPY OF 1.5 AT 135°, AND LINEAR DRIFT.

2- RESIDENTIAL WELL DATA INCLUDED IN ISOCONCENTRATION CONTOURS BUT POINT CONCENTRATIONS NOT SHOWN ON FIGURE.

Nº	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

CARBON TETRACHLORIDE ISOCONCENTRATION CONTOURS IN S2/S3 GROUNDWATER AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOURS

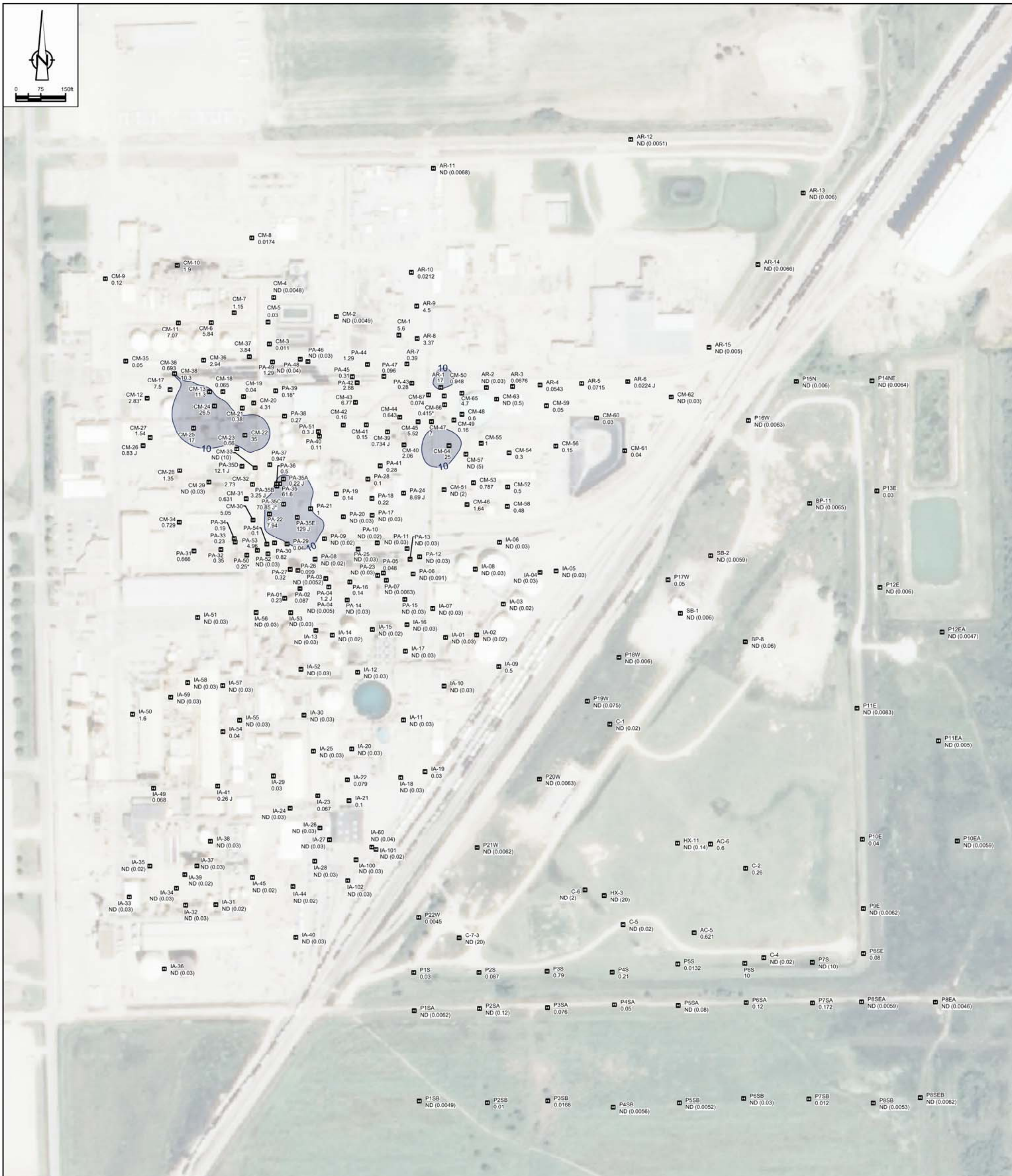
OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:	
B. CLEGG	S. SOUTTER	3/15/13	
Scale:	Project Nº:	Report Nº:	Drawing Nº:
#####	54046-D21111	036	figure I 16

54046-D21111(036)GN-CO074 MAR 15/2013



LEGEND:

10 CHLOROFORM ISOCONCENTRATION CONTOUR IN mg/kg

CM-1 5.6 SOIL SAMPLE LOCATION AND IDENTIFIER SOIL SAMPLE RESULT

ND NOT DETECTED

* AVERAGE VALUE OF CO-LOCATED RESULTS

^ ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

CHEMICAL NAME	INDUSTRIAL SOIL	UNITS
CHLOROFORM	1.5	mg/kg

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

No	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

CHLOROFORM ISOCONCENTRATION CONTOURS IN S2/S3 SOIL AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOUR

OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

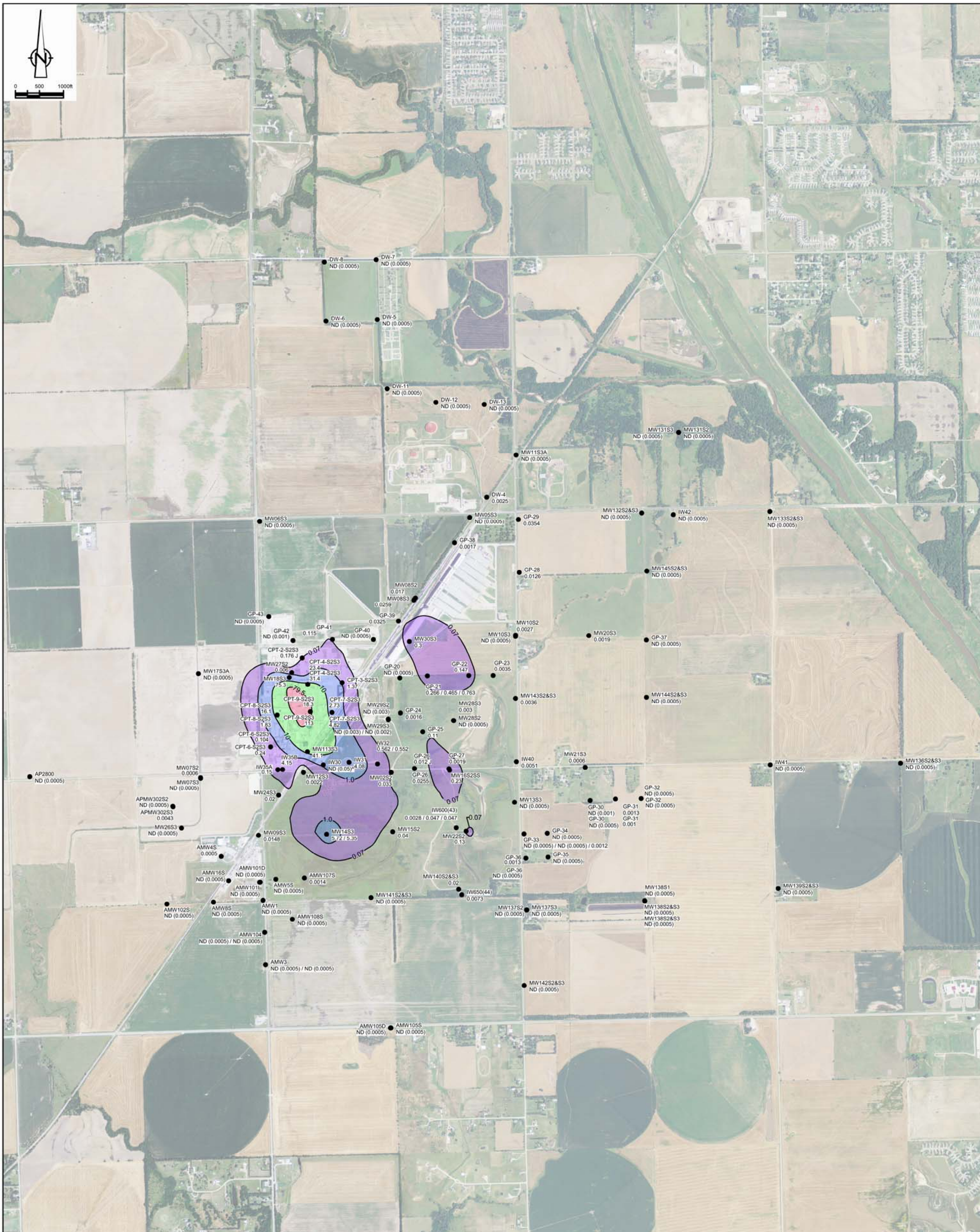
CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:
B. CLEGG	S. SOUTTER	3/15/13

Scale:	Project No:	Report No:	Drawing No:
1:150	54046-D21111	036	figure I 17

54046-D21111(036)GN-CO096 MAR 15/2013



LEGEND:

0.07	CHLOROFORM ISOCONCENTRATION CONTOUR IN mg/L
AMW1 ● ND (0.00005)	MONITORING WELL LOCATION AND IDENTIFIER GROUNDWATER SAMPLE RESULT mg/L
ND (0.00005)	NOT DETECTED
*	AVERAGE VALUE OF CO-LOCATED RESULTS
^	ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

GROUNDWATER CRITERIA			
CHEMICAL NAME	MCL	TAP WATER	UNITS
CHLOROFORM	0.08	0.00019	mg/L

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

NOTES:

1- ISOCONCENTRATION CONTOURS WERE GENERATED BASED ON THE MAY 2012 GROUNDWATER SAMPLING EVENT, THE MAY 2012 CPT GROUNDWATER SAMPLING, AND THE SEPTEMBER 2012 GEOPROBE SAMPLING REPRESENTATIVE OF THE S2/S3 AQUIFER USING SURFER 7, LOG10 TRANSFORMED DATA, HALF THE MEDIAN LIMIT FOR NON-DETECTION VALUES, LINEAR 1:1 VARIOGRAM WITH ANISOTROPY OF 1.5 AT 135°, AND LINEAR DRIFT.

2- RESIDENTIAL WELL DATA INCLUDED IN ISONCENTRATION CONTOURS BUT POINT CONCENTRATIONS NOT SHOWN ON FIGURE.

Nº	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

CHLORFORM ISOCONCENTRATION CONTOURS IN S2/S3 GROUNDWATER AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOURS

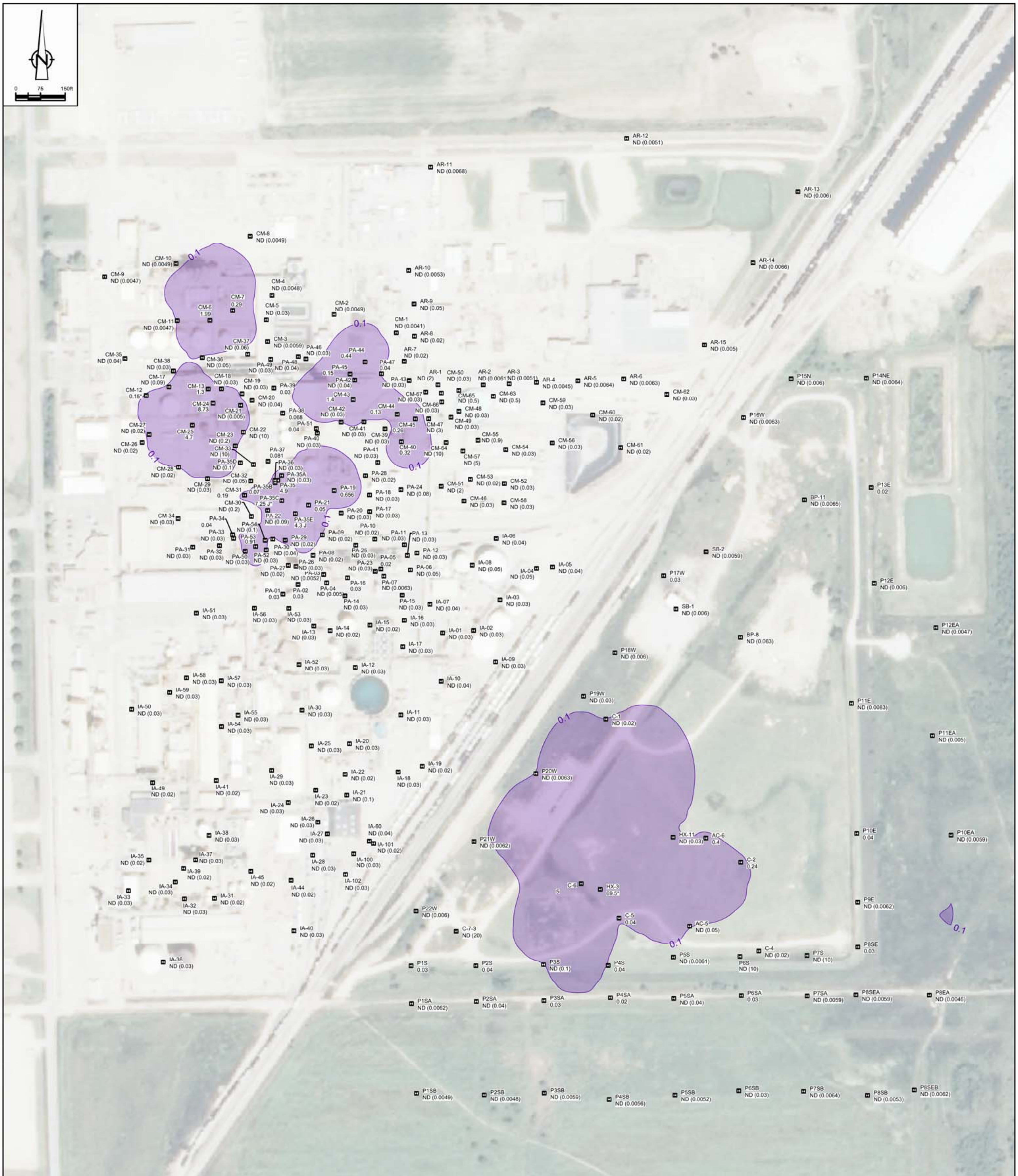
OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:	
B. CLEGG	S. SOUTTER	3/15/13	
Scale:	Project Nº:	Report Nº:	Drawing Nº:
#####	54046-D21111	036	figure I 18

54046-D21111(036)GN-CO075 MAR 15/2013



LEGEND:

0.1 METHYLENE CHLORIDE ISOCONCENTRATION CONTOUR IN mg/kg

CM-1 ND (0.02) SOIL SAMPLE LOCATION AND IDENTIFIER SOIL SAMPLE RESULT

ND NOT DETECTED

* AVERAGE VALUE OF CO-LOCATED RESULTS

^ ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

CHEMICAL NAME	INDUSTRIAL SOIL	UNITS
METHYLENE CHLORIDE	960	mg/kg

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

Nº	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

METHYLENE CHLORIDE ISOCONCENTRATION CONTOURS IN SOIL AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOUR

OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

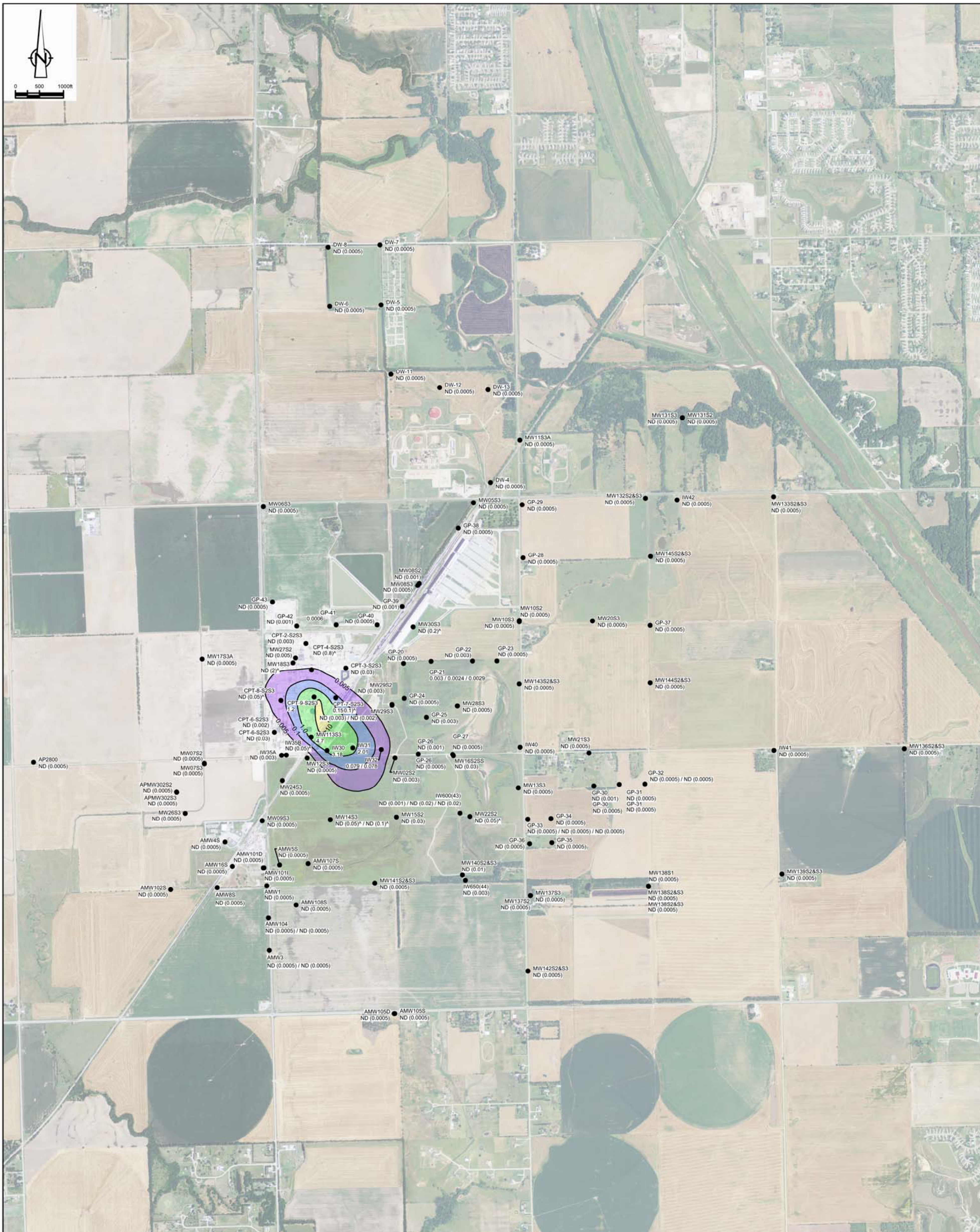
CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:
B. CLEGG	S. SOUTTER	3/15/13

Scale:	Project Nº:	Report Nº:	Drawing Nº:
1:150	54046-D21111	036	figure I 19

54046-D21111(036)GN-CO101 MAR 15/2013



LEGEND:

0.005	METHYLENE CHLORIDE ISOCONCENTRATION CONTOUR IN mg/L
AMW1 ● ND (0.00005)	MONITORING WELL LOCATION AND IDENTIFIER GROUNDWATER SAMPLE RESULT mg/L
ND (0.00005)	NOT DETECTED
*	AVERAGE VALUE OF CO-LOCATED RESULTS
^	ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

GROUNDWATER CRITERIA

CHEMICAL NAME	MCL	TAP WATER	UNITS
METHYLENE CHLORIDE	0.005	0.0099	mg/L

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

NOTES:

1- ISOCONCENTRATION CONTOURS WERE GENERATED BASED ON THE MAY 2012 GROUNDWATER SAMPLING EVENT, THE MAY 2012 CPT GROUNDWATER SAMPLING, AND THE SEPTEMBER 2012 GEOPROBE SAMPLING REPRESENTATIVE OF THE S2/S3 AQUIFER USING SURFER 7, LOG10 TRANSFORMED DATA, HALF THE MEDIAN LIMIT FOR NON-DETECTION VALUES, LINEAR 1:1 VARIOGRAM WITH ANISOTROPY OF 1.5 AT 135°, AND LINEAR DRIFT.

2- RESIDENTIAL WELL DATA INCLUDED IN ISOCONCENTRATION CONTOURS BUT POINT CONCENTRATIONS NOT SHOWN ON FIGURE.

No	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

METHYLENE CHLORIDE ISOCONCENTRATION CONTOURS IN S2/S3 GROUNDWATER AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOURS

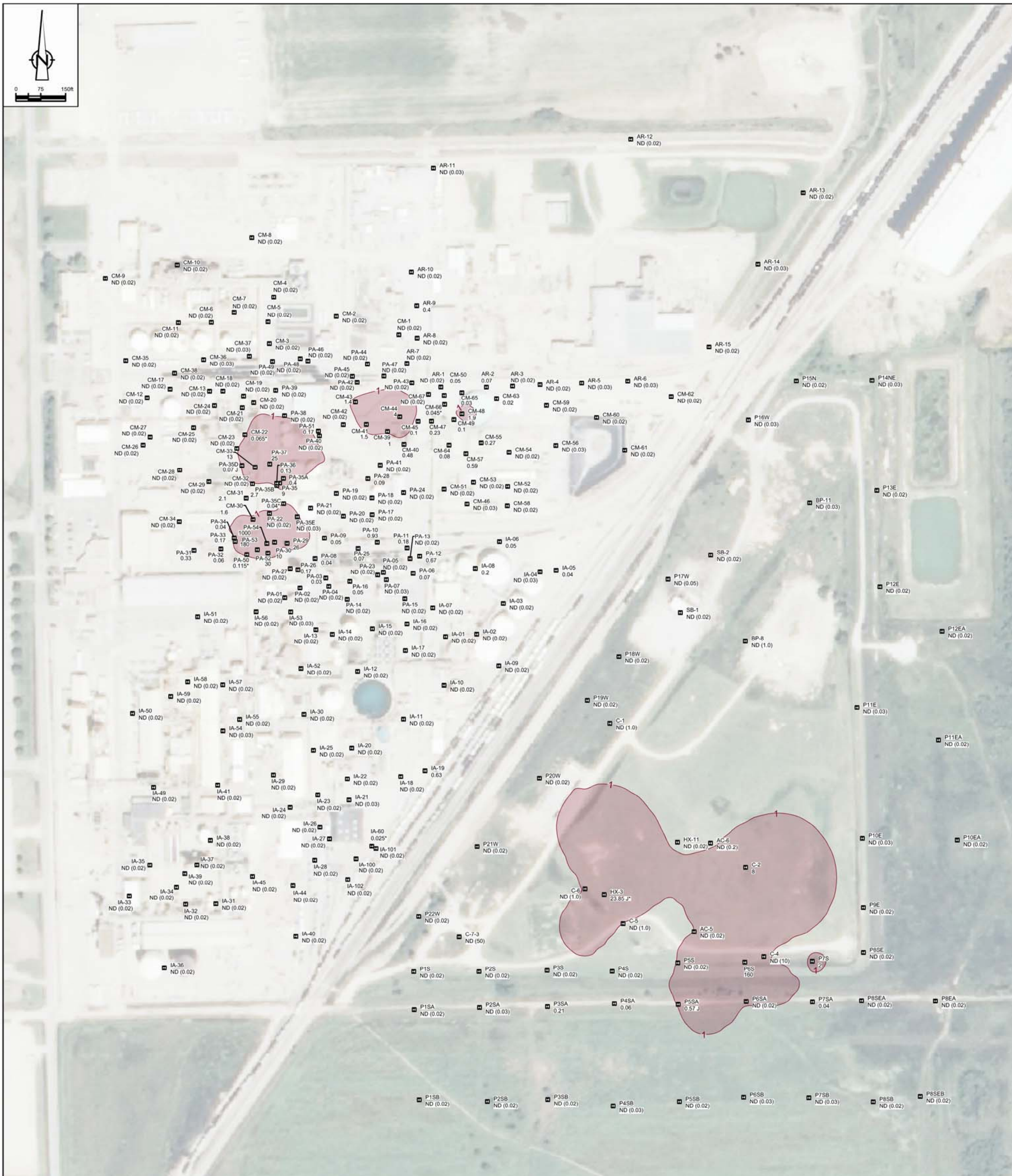
OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:	
B. CLEGG	S. SOUTTER	3/15/13	
Scale:	Project No:	Report No:	Drawing No:
#####	54046-D21111	036	figure I 20

54046-D21111(036)GN-CO080 MAR 15/2013



LEGEND:

PENTACHLOROPHENOL ISOCONCENTRATION CONTOUR IN mg/kg

CM-1 ND (0.02) — SOIL SAMPLE LOCATION AND IDENTIFIER SOIL SAMPLE RESULT

ND — NOT DETECTED

* — AVERAGE VALUE OF CO-LOCATED RESULTS

^ — ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

CHEMICAL NAME	INDUSTRIAL SOIL	UNITS
PENTACHLOROPHENOL	2.7	mg/kg

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

No	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

PENTACHLOROPHENOL ISOCONCENTRATION CONTOURS IN SOIL AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOUR

OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

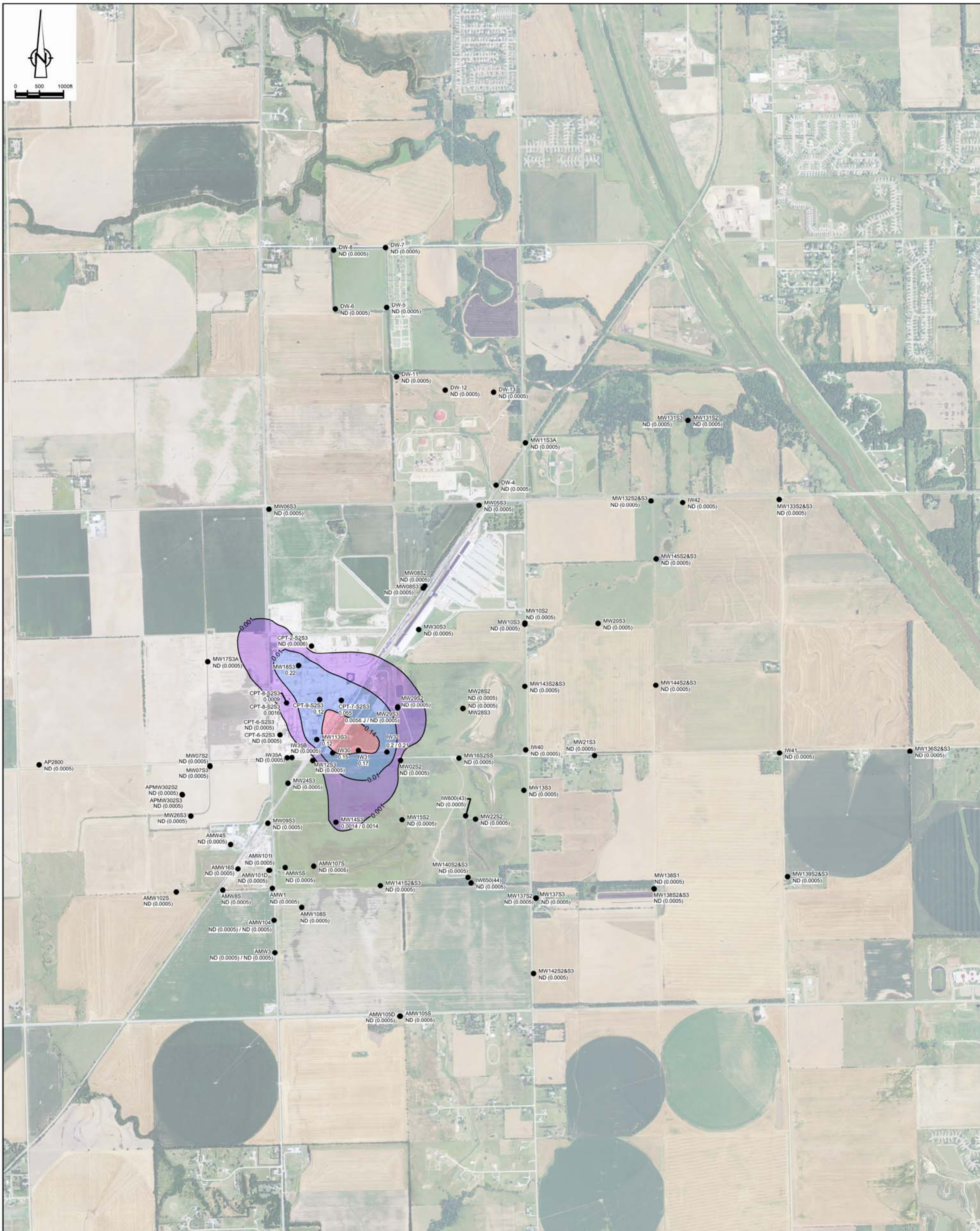
CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:
B. CLEGG	S. SOUTTER	3/15/13

Scale:	Project No:	Report No:	Drawing No:
1:150	54046-D21111	036	figure I 21

54046-D21111(036)GN-CO102 MAR 15/2013



LEGEND:

0.001	PENTACHLOROPHENOL ISOCONCENTRATION CONTOUR IN mg/L
AMW1 ● ND (0.00005)	MONITORING WELL LOCATION AND IDENTIFIER GROUNDWATER SAMPLE RESULT mg/L
ND (0.00005)	NOT DETECTED
*	AVERAGE VALUE OF CO-LOCATED RESULTS
^	ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

GROUNDWATER CRITERIA			
CHEMICAL NAME	MCL	TAP WATER	UNITS
PENTACHLOROPHENOL	0.001	0.000035	mg/L

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

NOTES:

1- ISCONCENTRATION CONTOURS WERE GENERATED BASED ON THE MAY 2012 GROUNDWATER SAMPLING EVENT, THE MAY 2012 CPT GROUNDWATER SAMPLING, AND THE SEPTEMBER 2012 GEOPROBE SAMPLING REPRESENTATIVE OF THE S2/S3 AQUIFER USING SURFER 7, LOG10 TRANSFORMED DATA, HALF THE MEDIAN LIMIT FOR NON-DETECTION VALUES, LINEAR 1:1 VARIOGRAM WITH ANISOTROPY OF 1.5 AT 135°, AND LINEAR DRIFT.

2- RESIDENTIAL WELL DATA INCLUDED IN ISONCENTRATION CONTOURS BUT POINT CONCENTRATIONS NOT SHOWN ON FIGURE.

Nº	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

PENTACHLOROPHENOL ISOCONCENTRATION CONTOURS IN S2/S3 GROUNDWATER AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOURS

OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:	
B. CLEGG	S. SOUTTER	3/15/13	
Scale: #####	Project Nº: 54046-D21111	Report Nº: 036	Drawing Nº: figure I 22

54046-D21111(036)GN-CO081 MAR 15/2013

LEGEND:

10 2,3,4,6-TETRACHLOROPHENOL ISOCONCENTRATION CONTOUR IN MG/KG

CM-1 ND (0.0041) SOIL SAMPLE LOCATION AND IDENTIFIER SOIL SAMPLE RESULT

ND NOT DETECTED

* AVERAGE VALUE OF CO-LOCATED RESULTS

^ ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

CHEMICAL NAME	INDUSTRIAL SOIL	UNITS
2,3,4,6-TETRACHLOROPHENOL	18,000	mg/kg

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

No	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

2,3,4,6-TETRACHLOROPHENOL ISOCONCENTRATION CONTOURS IN SOIL AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOUR

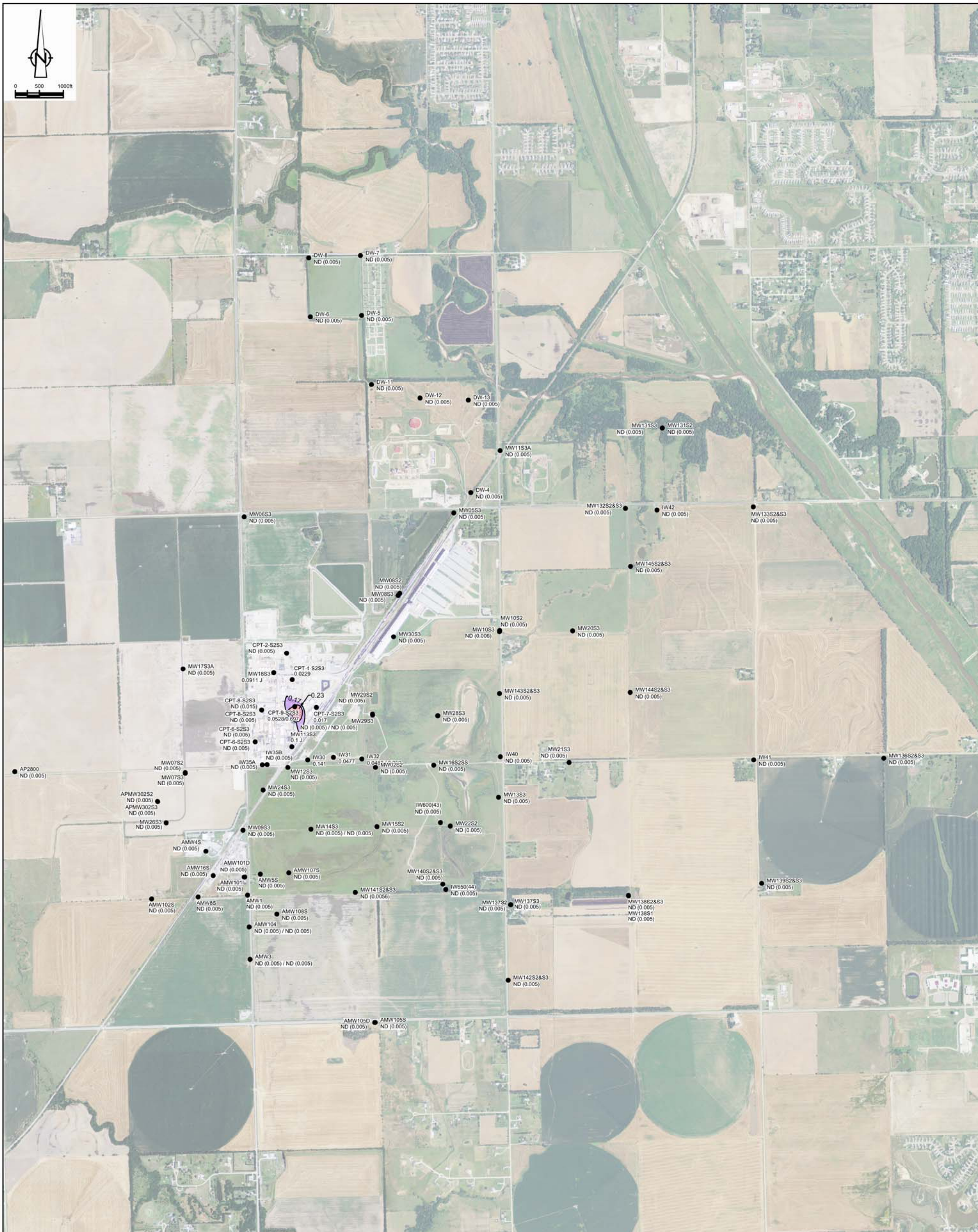
OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:	
B. CLEGG	S. SOUTTER	3/15/13	
Scale:	Project No:	Report No:	Drawing No:
1:150	54046-D21111	036	figure I 23

54046-D21111(036)GN-CO086 MAR 15/2013



LEGEND:

(0.17) 2,3,4,6-TETRACHLOROPHENOL ISOCONCENTRATION CONTOUR IN mg/L

AMW1 ● MONITORING WELL LOCATION AND IDENTIFIER
ND (0.005) GROUNDWATER SAMPLE RESULT mg/L

ND (0.005) NOT DETECTED

* AVERAGE VALUE OF CO-LOCATED RESULTS

^ ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

GROUNDWATER CRITERIA			
CHEMICAL NAME	MCL	TAP WATER	UNITS
2,3,4,6-TETRACHLOROPHENOL	--	0.17	mg/L

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

NOTES:

1- ISCONCENTRATION CONTOURS WERE GENERATED BASED ON THE MAY 2012 GROUNDWATER SAMPLING EVENT, THE MAY 2012 CPT GROUNDWATER SAMPLING, AND THE SEPTEMBER 2012 GEOPROBE SAMPLING REPRESENTATIVE OF THE S2/S3 AQUIFER USING SURFER 7, LOG10 TRANSFORMED DATA, HALF THE MEDIAN LIMIT FOR NON-DETECTION VALUES, LINEAR 1:1 VARIOGRAM WITH ANISOTROPY OF 1.5 AT 135°, AND LINEAR DRIFT.

2- RESIDENTIAL WELL DATA INCLUDED IN ISONCENTRATION CONTOURS BUT POINT CONCENTRATIONS NOT SHOWN ON FIGURE.

No	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

2,3,4,6-TETRACHLOROPHENOL ISOCONCENTRATION CONTOURS IN S2/S3 GROUNDWATER AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOURS

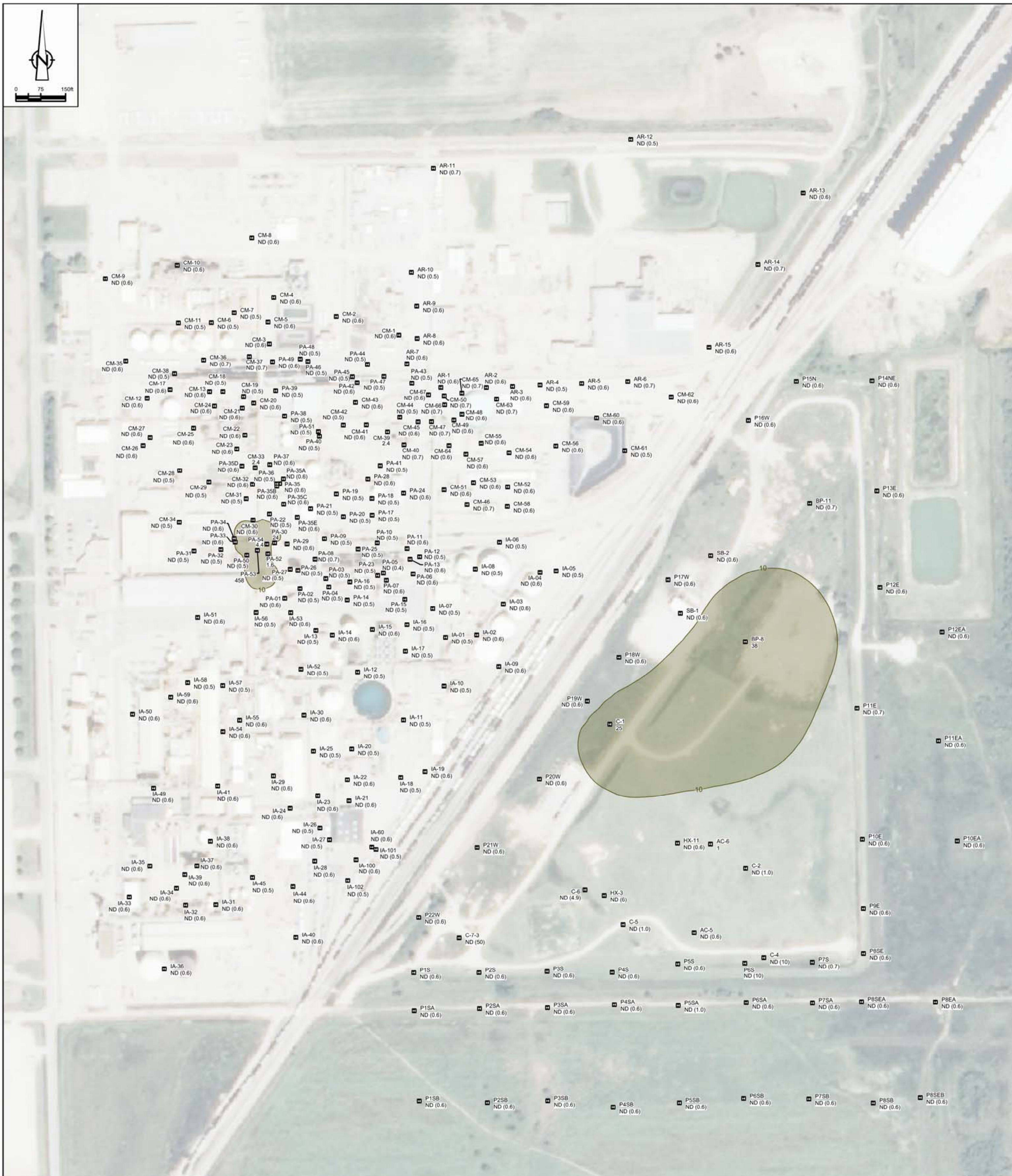
OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:	
B. CLEGG	S. SOUTTER	3/15/13	
Scale:	Project No:	Report No:	Drawing No:
#####	54046-D21111	036	figure I 24

54046-D21111(036)GN-CO066 MAR 15/2013



LEGEND:

10 — 2,4,6-TRICHLOROPHENOL ISOCONCENTRATION CONTOUR IN mg/kg

CM-1 ND (0.6) — SOIL SAMPLE LOCATION AND IDENTIFIER SOIL SAMPLE RESULT

ND — NOT DETECTED

★ — AVERAGE VALUE OF CO-LOCATED RESULTS

^ — ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

CHEMICAL NAME	INDUSTRIAL SOIL	UNITS
2,4,6-TRICHLOROPHENOL	160	mg/kg

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

No	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

2,4,6-TRICHLOROPHENOL ISOCONCENTRATION CONTOURS IN SOIL AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOUR

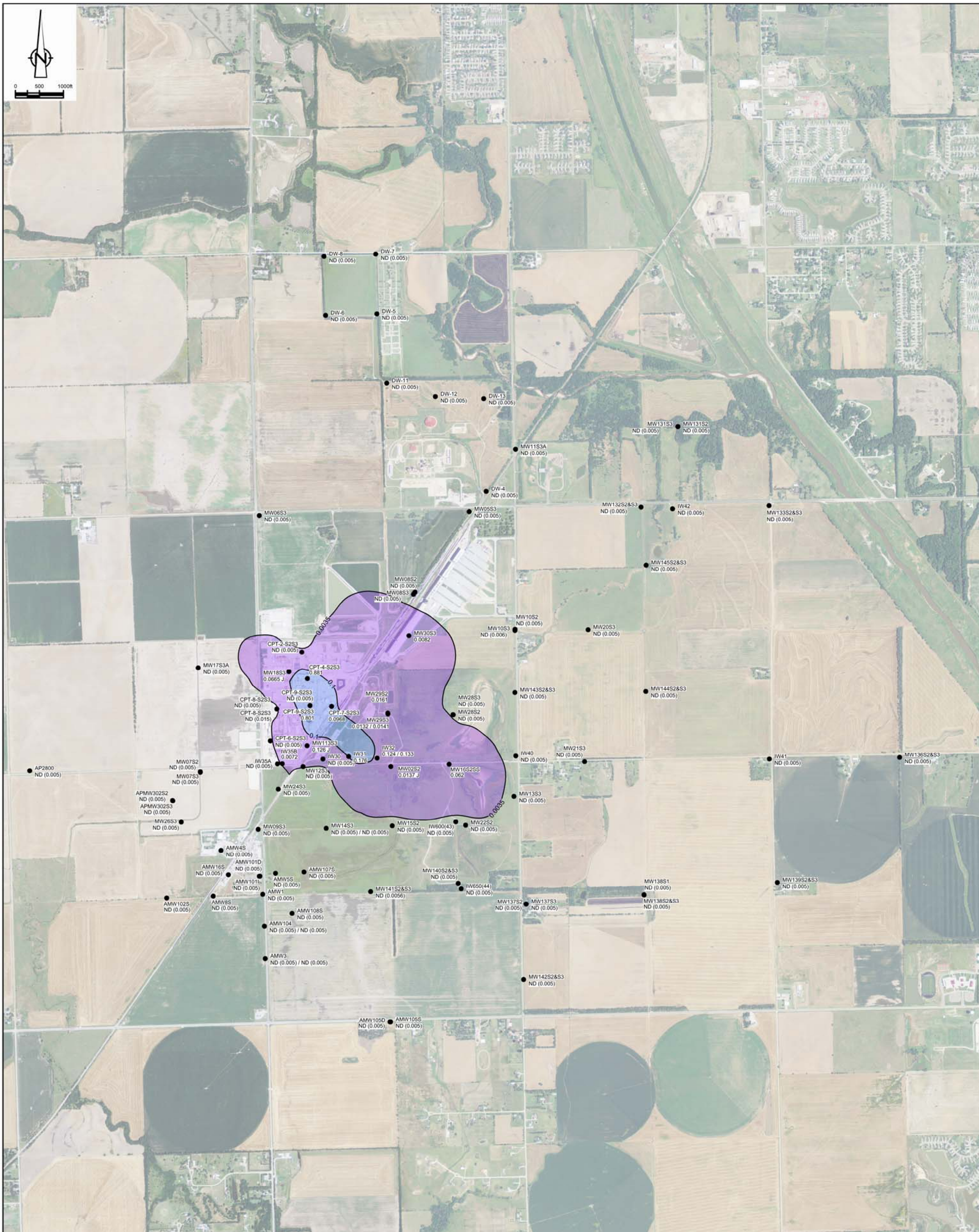
OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:	
B. CLEGG	S. SOUTTER	3/15/13	
Scale:	Project No:	Report No:	Drawing No:
1:150	54046-D21111	036	figure I 25

54046-D21111(036)GN-CO088 MAR 15/2013



LEGEND:

0.0035 2,4,6-TRICHLOROPHENOL ISOCONCENTRATION CONTOUR IN mg/L

AMW1 ● MONITORING WELL LOCATION AND IDENTIFIER
ND (0.005) GROUNDWATER SAMPLE RESULT mg/L

ND (0.005) NOT DETECTED

* AVERAGE VALUE OF CO-LOCATED RESULTS

^ ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

GROUNDWATER CRITERIA			
CHEMICAL NAME	MCL	TAP WATER	UNITS
2,4,6-TRICHLOROPHENOL	--	0.0035	mg/L

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

NOTES:

1- ISCONCENTRATION CONTOURS WERE GENERATED BASED ON THE MAY 2012 GROUNDWATER SAMPLING EVENT, THE MAY 2012 CPT GROUNDWATER SAMPLING, AND THE SEPTEMBER 2012 GEOPROBE SAMPLING REPRESENTATIVE OF THE S2/S3 AQUIFER USING SURFER 7, LOG10 TRANSFORMED DATA, HALF THE MEDIAN LIMIT FOR NON-DETECTION VALUES, LINEAR 1:1 VARIOGRAM WITH ANISOTROPY OF 1.5 AT 135°, AND LINEAR DRIFT.

2- RESIDENTIAL WELL DATA INCLUDED IN ISONCENTRATION CONTOURS BUT POINT CONCENTRATIONS NOT SHOWN ON FIGURE.

Nº	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

2,4,6-TRICHLOROPHENOL ISOCONCENTRATION CONTOURS IN S2/S3 GROUNDWATER AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOURS

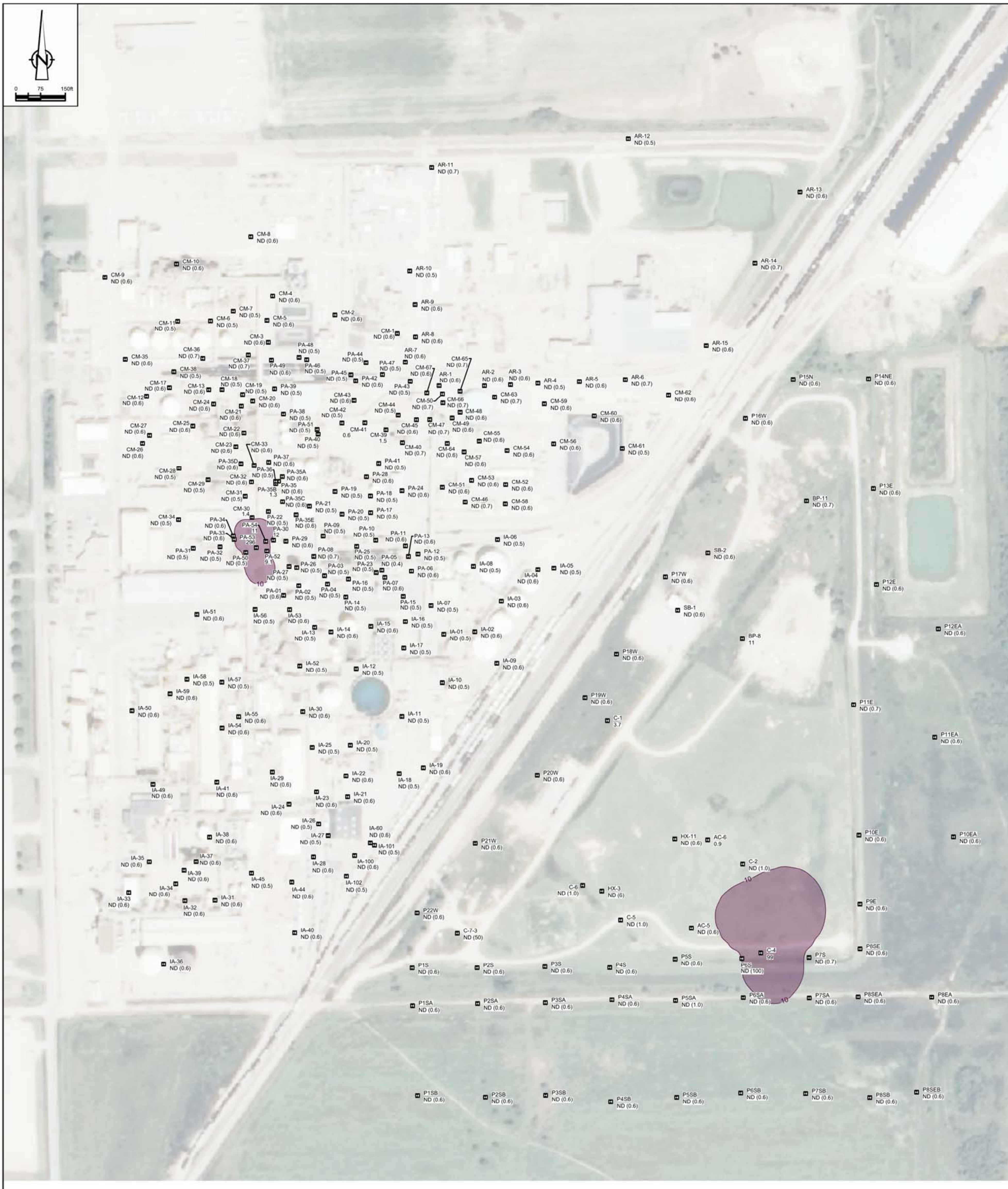
OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:	
B. CLEGG	S. SOUTTER	3/15/13	
Scale:	Project Nº:	Report Nº:	Drawing Nº:
#####	54046-D21111	036	figure I 26

54046-D21111(036)GN-CO067 MAR 15/2013



LEGEND:

10 — 2,4-DICHLOROPHENOL ISOCONCENTRATION CONTOUR IN mg/kg

CM-1 ND (0.6) — SOIL SAMPLE LOCATION AND IDENTIFIER / SOIL SAMPLE RESULT

ND — NOT DETECTED

* — AVERAGE VALUE OF CO-LOCATED RESULTS

^ — ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

CHEMICAL NAME	INDUSTRIAL SOIL	UNITS
2,4-DICHLOROPHENOL	1,800	mg/kg

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

No	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

2,4-DICHLOROPHENOL ISOCONCENTRATION CONTOURS IN SOIL AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOUR

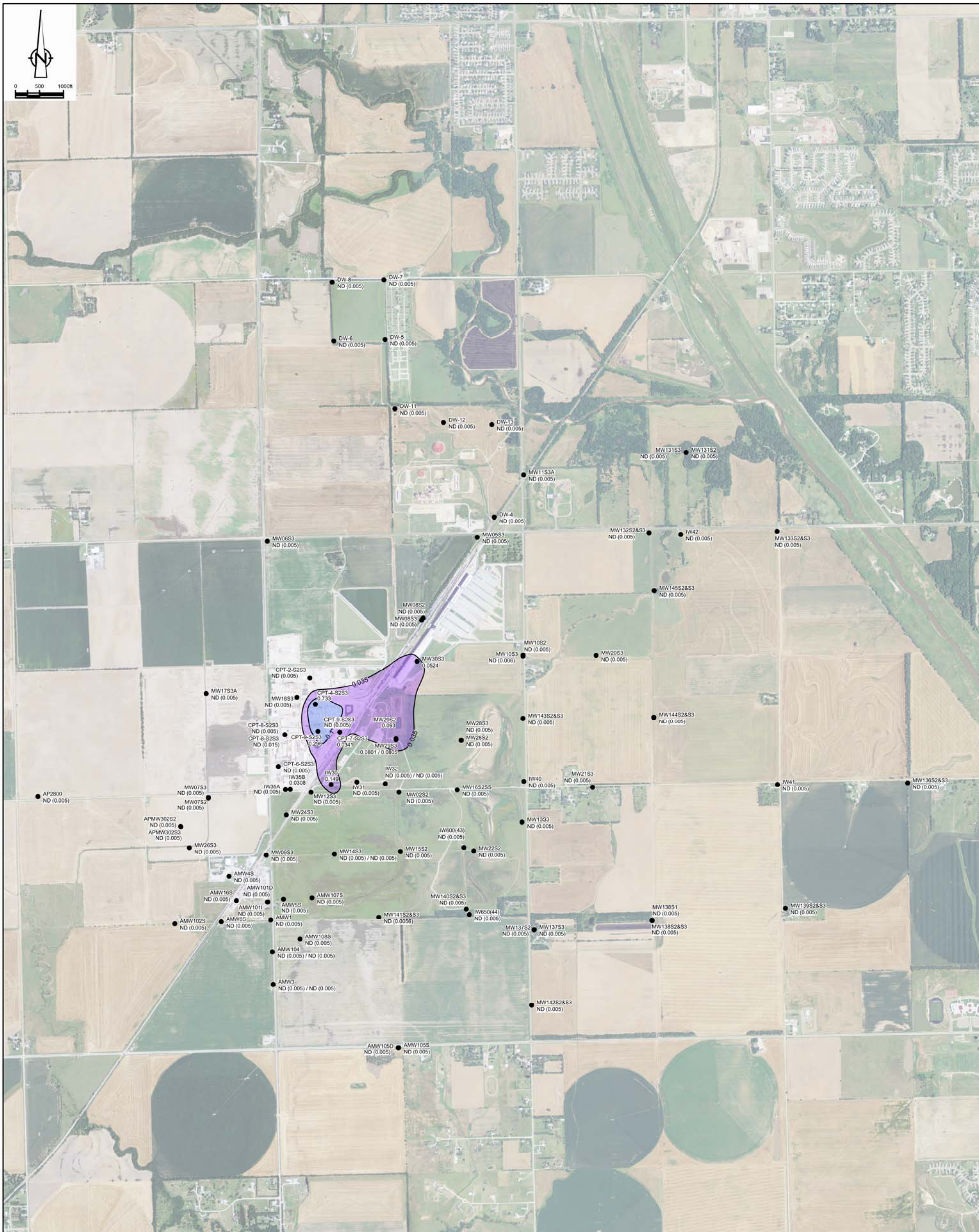
OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:	
B. CLEGG	S. SOUTTER	3/15/13	
Scale: 1:150	Project No: 54046-D21111	Report No: 036	Drawing No: figure I 27

54046-D21111(036)GN-CO089 MAR 15/2013



LEGEND:

0.035 2,4-DICHLOROPHENOL ACID ISOCONCENTRATION CONTOUR IN MG/L

AMW1 ● MONITORING WELL LOCATION AND IDENTIFIER
ND (0.005) GROUNDWATER SAMPLE RESULT mg/L

ND (0.005) NOT DETECTED

* AVERAGE VALUE OF CO-LOCATED RESULTS

^ ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

GROUNDWATER CRITERIA			
CHEMICAL NAME	MCL	TAP WATER	UNITS
2,4-DICHLOROPHENOL	--	0.035	mg/L

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

NOTES:

1- ISCONCENTRATION CONTOURS WERE GENERATED BASED ON THE MAY 2012 GROUNDWATER SAMPLING EVENT, THE MAY 2012 CPT GROUNDWATER SAMPLING, AND THE SEPTEMBER 2012 GEOPROBE SAMPLING REPRESENTATIVE OF THE S2/S3 AQUIFER USING SURFER 7, LOG10 TRANSFORMED DATA, HALF THE MEDIAN LIMIT FOR NON-DETECTION VALUES, LINEAR 1:1 VARIOGRAM WITH ANISOTROPY OF 1.5 AT 135°, AND LINEAR DRIFT.

2- RESIDENTIAL WELL DATA INCLUDED IN ISONCENTRATION CONTOURS BUT POINT CONCENTRATIONS NOT SHOWN ON FIGURE.

Nº	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

2,4-DICHLOROPHENOL ISOCONCENTRATION CONTOURS IN S2/S3 GROUNDWATER AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOURS

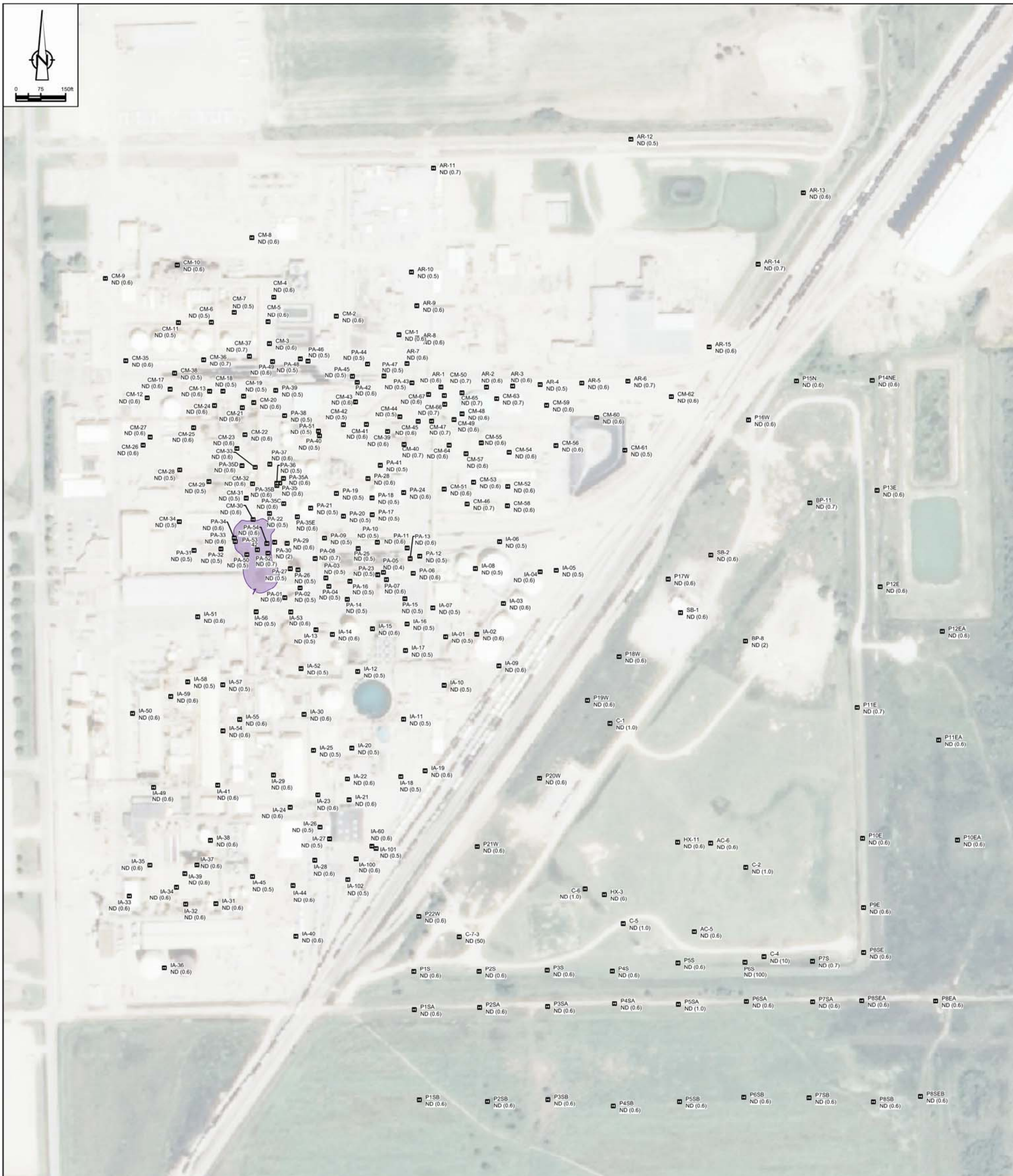
OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:	
B. CLEGG	S. SOUTTER	3/15/13	
Scale: #####	Project Nº: 54046-D21111	Report Nº: 036	Drawing Nº: figure I 28

54046-D21111(036)GN-CO068 MAR 15/2013



LEGEND:

1 — 2-CHLOROPHENOL ISOCONCENTRATION CONTOUR IN mg/kg

CM-1 ND (0.02) — SOIL SAMPLE LOCATION AND IDENTIFIER; SOIL SAMPLE RESULT

ND — NOT DETECTED

* — AVERAGE VALUE OF CO-LOCATED RESULTS

^ — ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

CHEMICAL NAME	INDUSTRIAL SOIL	UNITS
2-CHLOROPHENOL	5,100	mg/kg

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

№	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

2-CHLOROPHENOL ISOCONCENTRATION CONTOURS IN SOIL AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOUR

OCCIDENTAL CHEMICAL CORPORATION WICHITA, KANSAS

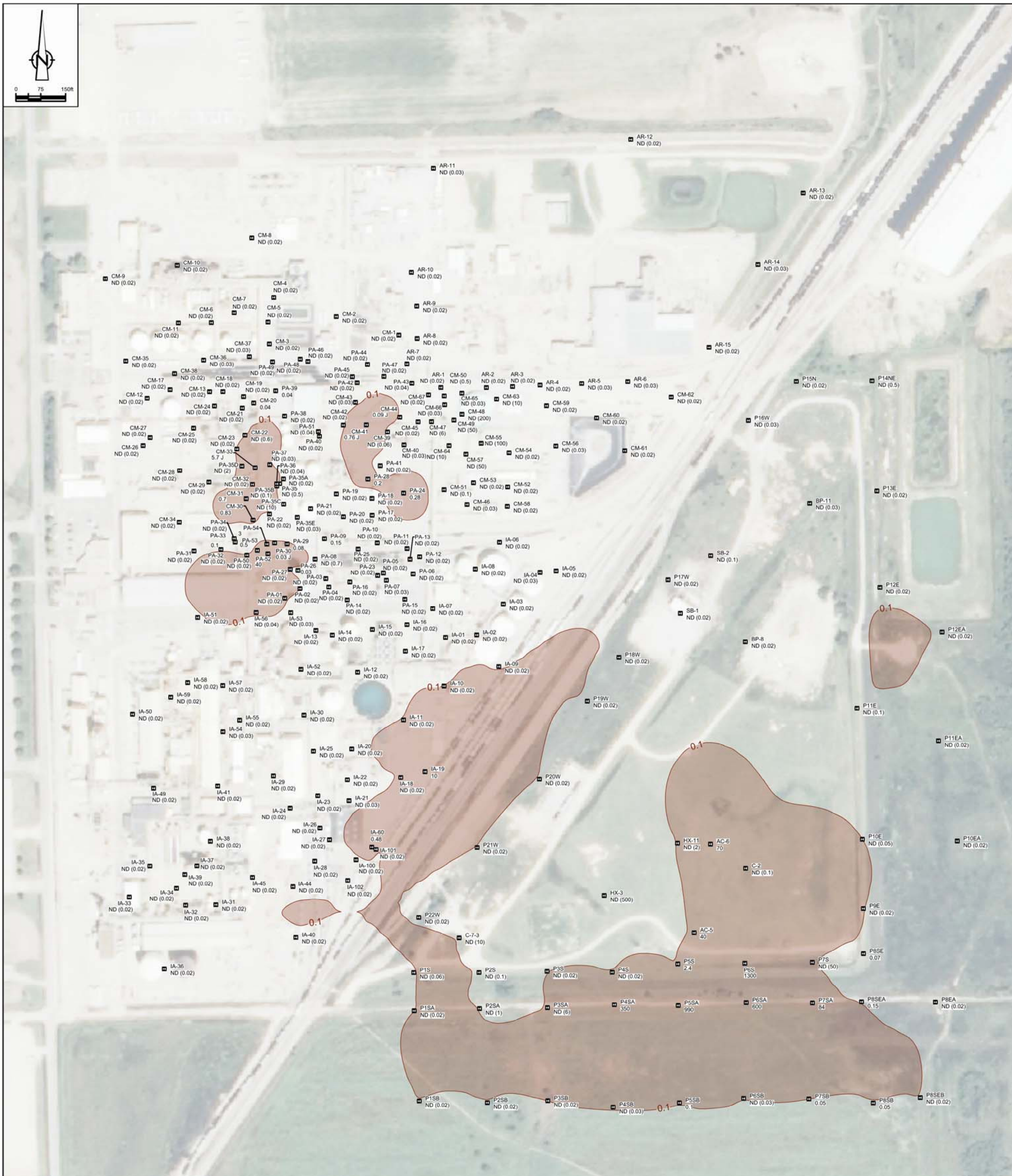
CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:
B. CLEGG	S. SOUTTER	3/15/13

Scale:	Project №:	Report №:	Drawing №:
1:150	54046-D21111	036	figure I 29

54046-D21111(036)GN-CO091 MAR 15/2013



LEGEND:

0.1 ALPHA-BHC ISOCONCENTRATION CONTOUR IN mg/kg

CM-1 ND (0.02) SOIL SAMPLE LOCATION AND IDENTIFIER SOIL SAMPLE RESULT

ND NOT DETECTED

* AVERAGE VALUE OF CO-LOCATED RESULTS

^ ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

CHEMICAL NAME	INDUSTRIAL SOIL	UNITS
ALPHA-BHC	0.27	mg/kg

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

No	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

ALPHA-BHC ISOCONCENTRATION CONTOURS IN SOIL AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOUR

OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

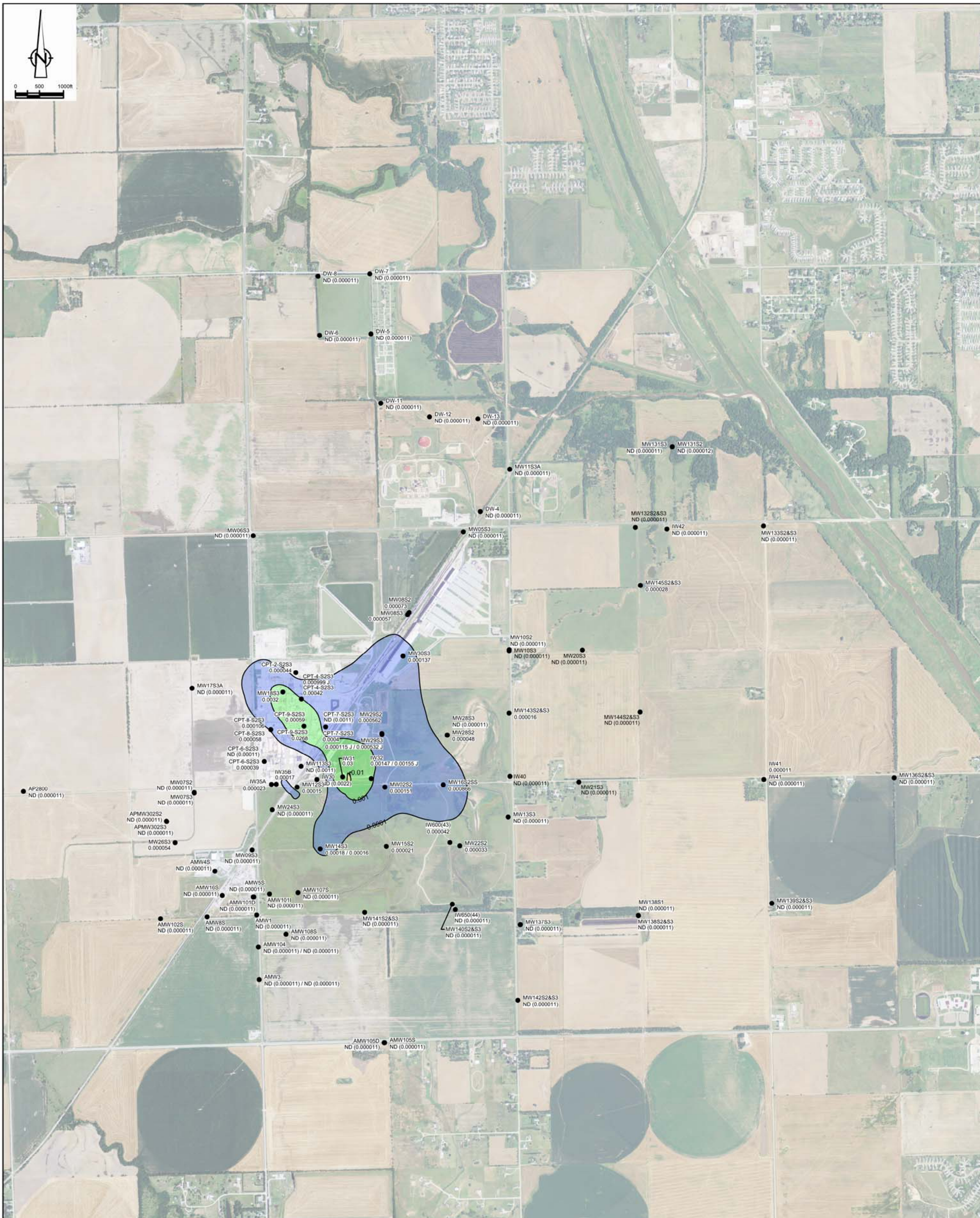
CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager: B. CLEGG | Reviewed By: S. SOUTTER | Date: 3/15/13

Scale: 1:150 | Project №: 54046-D21111 | Report №: 036 | Drawing №: figure I 30

54046-D21111(036)GN-CO092 MAR 15/2013



LEGEND:

- 0.0001 ALPHA-BHC ISOCONCENTRATION CONTOUR IN mg/L
- AMW1 ● MONITORING WELL LOCATION AND IDENTIFIER
  ND (0.00005) GROUNDWATER SAMPLE RESULT mg/L
- ND (0.00005) NOT DETECTED
- * AVERAGE VALUE OF CO-LOCATED RESULTS
- ^ ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

GROUNDWATER CRITERIA			
CHEMICAL NAME	MCL	TAP WATER	UNITS
ALPHA-BHC	--	0.0000062	mg/L

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

NOTES:

1- ISOCONCENTRATION CONTOURS WERE GENERATED BASED ON THE MAY 2012 GROUNDWATER SAMPLING EVENT, THE MAY 2012 CPT GROUNDWATER SAMPLING, AND THE SEPTEMBER 2012 GEOPROBE SAMPLING REPRESENTATIVE OF THE S2/S3 AQUIFER USING SURFER 7, LOG10 TRANSFORMED DATA, HALF THE MEDIAN LIMIT FOR NON-DETECTION VALUES, LINEAR 1:1 VARIOGRAM WITH ANISOTROPY OF 1.5 AT 135°, AND LINEAR DRIFT.

2- RESIDENTIAL WELL DATA INCLUDED IN ISONCENTRATION CONTOURS BUT POINT CONCENTRATIONS NOT SHOWN ON FIGURE.

No	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

ALPHA-BHC ISOCONCENTRATION CONTOURS IN S2/S3 GROUNDWATER AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOURS

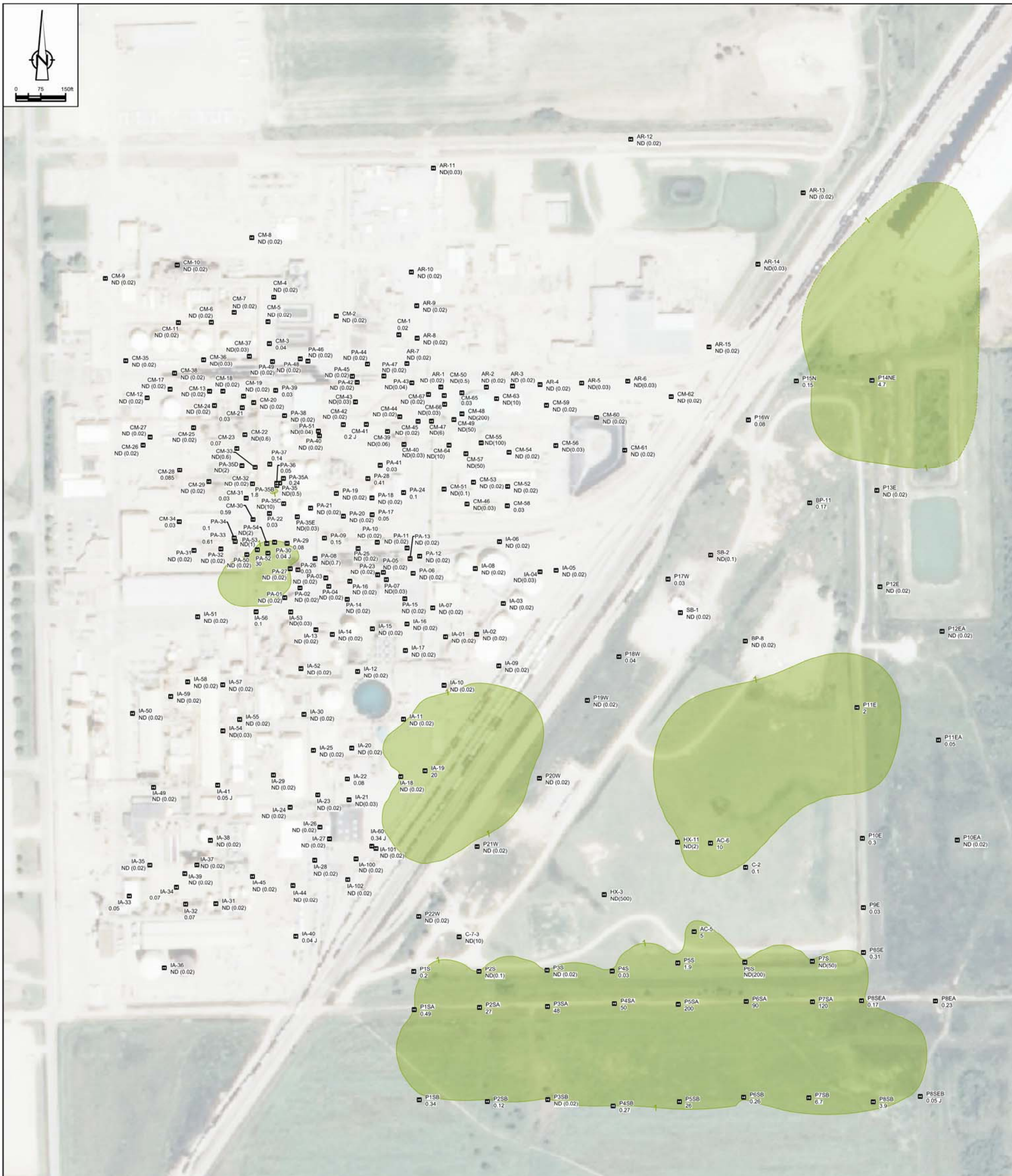
OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:	
B. CLEGG	S. SOUTTER	3/15/13	
Scale:	Project No:	Report No:	Drawing No:
#####	54046-D21111	036	figure I 31

54046-D21111(036)GN-CO071 MAR 15/2013



LEGEND:

1	BETA-BHC ISOCONCENTRATION CONTOUR IN mg/kg
CM-1 ND (0.02)	SOIL SAMPLE LOCATION AND IDENTIFIER SOIL SAMPLE RESULT
ND	NOT DETECTED
*	AVERAGE VALUE OF CO-LOCATED RESULTS
^	ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

CHEMICAL NAME	INDUSTRIAL SOIL	UNITS
BETA-BHC	0.96	mg/kg

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

№	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

BETA-BHC ISOCONCENTRATION CONTOURS IN SOIL AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOUR

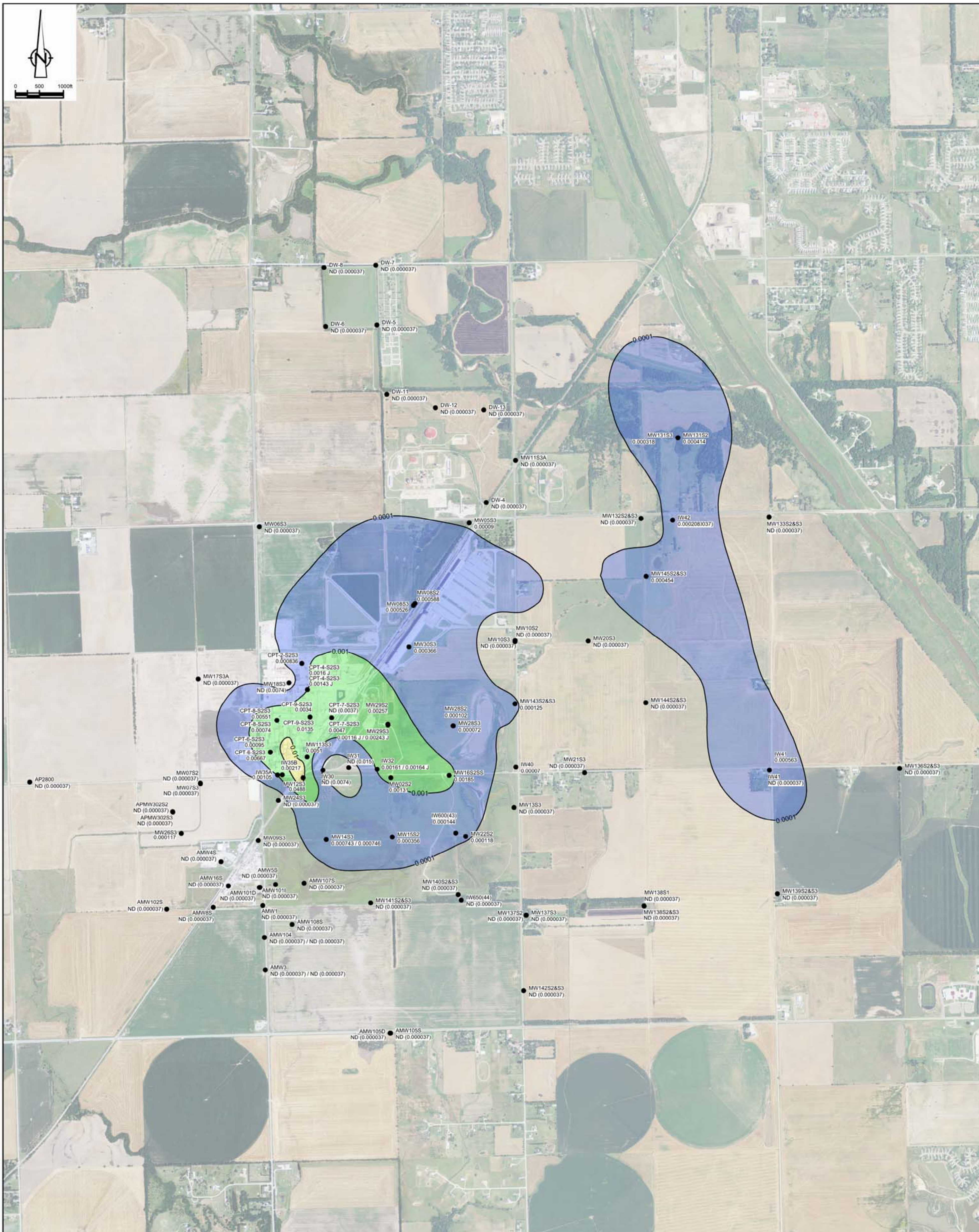
OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:	
B. CLEGG	S. SOUTTER	3/15/13	
Scale: 1:150	Project №: 54046-D21111	Report №: 036	Drawing №: figure I 32

54046-D21111(036)GN-CO094 MAR 15/2013



LEGEND:

0.0001 BETA-BHC ISOCONCENTRATION CONTOUR IN mg/L

AMW1 ND (0.00005) ● MONITORING WELL LOCATION AND IDENTIFIER GROUNDWATER SAMPLE RESULT mg/L

ND (0.00005) NOT DETECTED

* AVERAGE VALUE OF CO-LOCATED RESULTS

^ ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

GROUNDWATER CRITERIA			
CHEMICAL NAME	MCL	TAP WATER	UNITS
BETA-BHC	--	0.000022	mg/L

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

NOTES:

1- ISOCONCENTRATION CONTOURS WERE GENERATED BASED ON THE MAY 2012 GROUNDWATER SAMPLING EVENT, THE MAY 2012 CPT GROUNDWATER SAMPLING, AND THE SEPTEMBER 2012 GEOPROBE SAMPLING REPRESENTATIVE OF THE S2/S3 AQUIFER USING SURFER 7, LOG10 TRANSFORMED DATA, HALF THE MEDIAN LIMIT FOR NON-DETECTION VALUES, LINEAR 1:1 VARIOGRAM WITH ANISOTROPY OF 1.5 AT 135°, AND LINEAR DRIFT.

2- RESIDENTIAL WELL DATA INCLUDED IN ISONCENTRATION CONTOURS BUT POINT CONCENTRATIONS NOT SHOWN ON FIGURE

Nº	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

BETA-BHC ISOCONCENTRATION CONTOURS IN S2/S3 GROUNDWATER AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOURS

OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

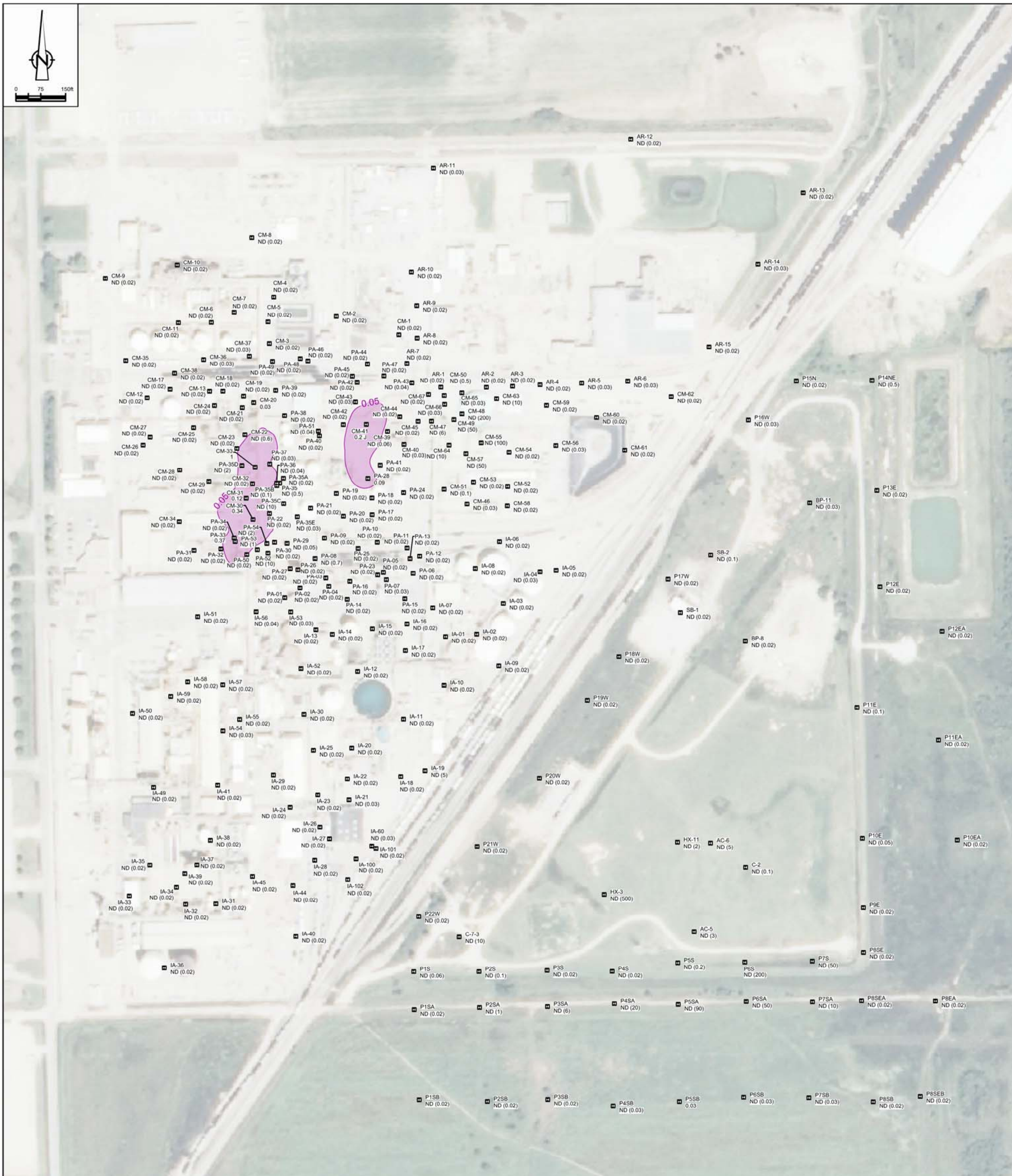
CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:
B. CLEGG	S. SOUTTER	3/15/13

Scale:	Project Nº:	Report Nº:	Drawing Nº:
#####	54046-D21111	036	figure I 33

54046-D21111(036)GN-CO073 MAR 15/2013



LEGEND:

0.05 GAMMA-BHC ISOCONCENTRATION CONTOUR IN mg/kg

CM-1 ND (0.02) SOIL SAMPLE LOCATION AND IDENTIFIER SOIL SAMPLE RESULT

ND NOT DETECTED

* AVERAGE VALUE OF CO-LOCATED RESULTS

^ ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

CHEMICAL NAME	INDUSTRIAL SOIL	UNITS
GAMMA-BHC	2.1	mg/kg

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

Nº	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

GAMMA-BHC ISOCONCENTRATION CONTOURS IN SOIL AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOUR

OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:	
B. CLEGG	S. SOUTTER	3/15/13	
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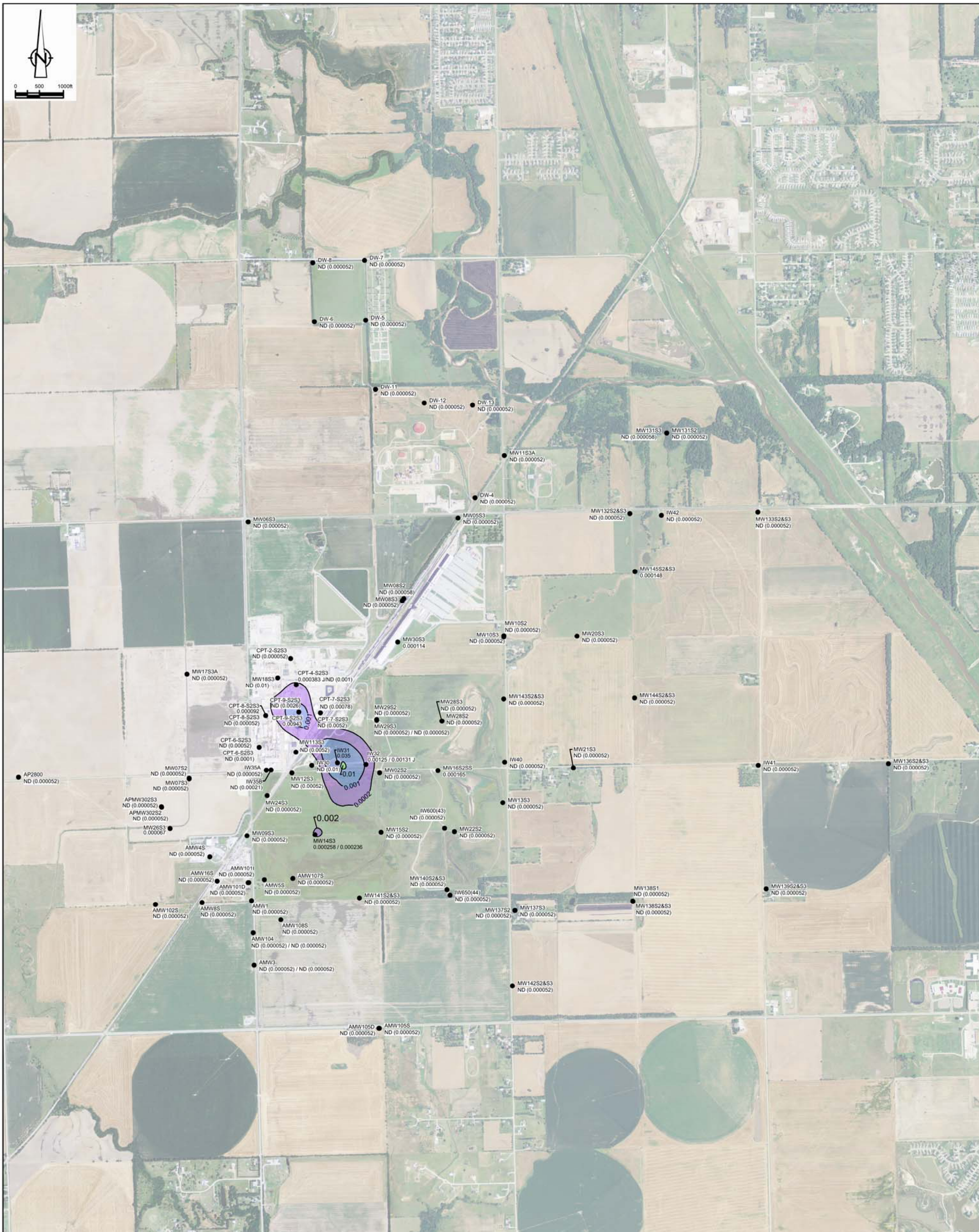
54046-D21111(036)GN-CO097 MAR 15/2013



LEGEND:

0.0002 GAMMA-BHC ISOCONCENTRATION CONTOUR IN mg/L

AMW1 ND (0.000052) ● MONITORING WELL LOCATION AND IDENTIFIER GROUNDWATER SAMPLE RESULT mg/L

ND (0.000052) NOT DETECTED

* AVERAGE VALUE OF CO-LOCATED RESULTS

^ ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

GROUNDWATER CRITERIA			
CHEMICAL NAME	MCL	TAP WATER	UNITS
GAMMA-BHC	0.0002	0.000036	mg/L

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

NOTES:

1- ISCONCENTRATION CONTOURS WERE GENERATED BASED ON THE MAY 2012 GROUNDWATER SAMPLING EVENT, THE MAY 2012 CPT GROUNDWATER SAMPLING, AND THE SEPTEMBER 2012 GEOPROBE SAMPLING REPRESENTATIVE OF THE S2/S3 AQUIFER USING SURFER 7, LOG10 TRANSFORMED DATA, HALF THE MEDIAN LIMIT FOR NON-DETECTION VALUES, LINEAR 1:1 VARIOGRAM WITH ANISOTROPY OF 1.5 AT 135°, AND LINEAR DRIFT.

2- RESIDENTIAL WELL DATA INCLUDED IN ISONCENTRATION CONTOURS BUT POINT CONCENTRATIONS NOT SHOWN ON FIGURE.

Nº	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

GAMMA-BHC ISOCONCENTRATION CONTOURS IN S2/S3 GROUNDWATER AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOURS

OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

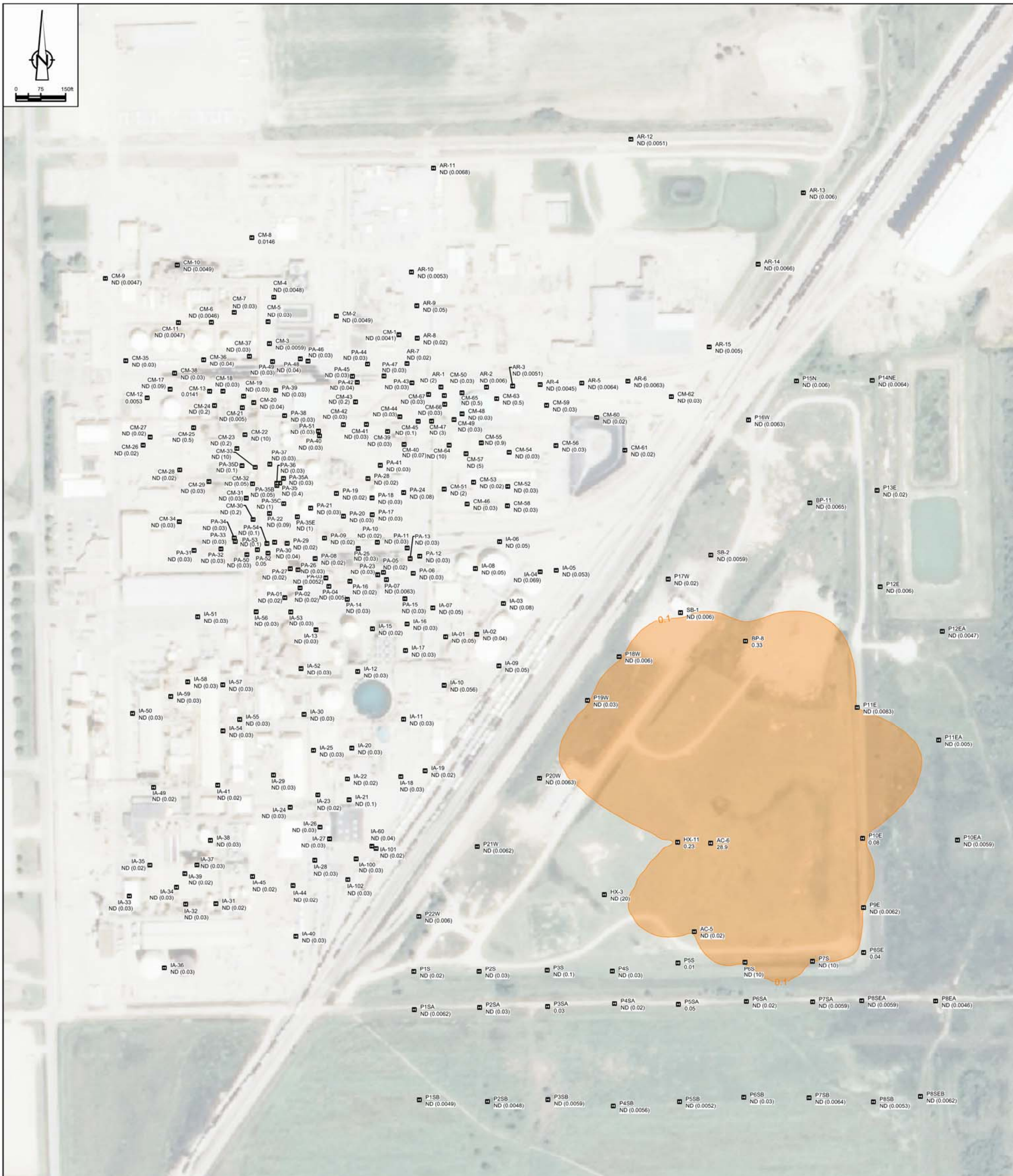
CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:
B. CLEGG	S. SOUTTER	3/15/13

Scale:	Project Nº:	Report Nº:	Drawing Nº:
#####	54046-D21111	036	figure I 35

54046-D21111(036)GN-CO076 MAR 15/2013



LEGEND:

0.1 BENZENE ISOCONCENTRATION CONTOUR IN mg/kg

CM-1
ND (0.02) SOIL SAMPLE LOCATION AND IDENTIFIER
SOIL SAMPLE RESULT

ND NOT DETECTED

* AVERAGE VALUE OF CO-LOCATED RESULTS

^ ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

CHEMICAL NAME	INDUSTRIAL SOIL	UNITS
BENZENE	5.4	mg/kg

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

Nº	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

BENZENE ISOCONCENTRATION CONTOURS IN SOIL AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOUR

OCCIDENTAL CHEMICAL CORPORATION WICHITA, KANSAS

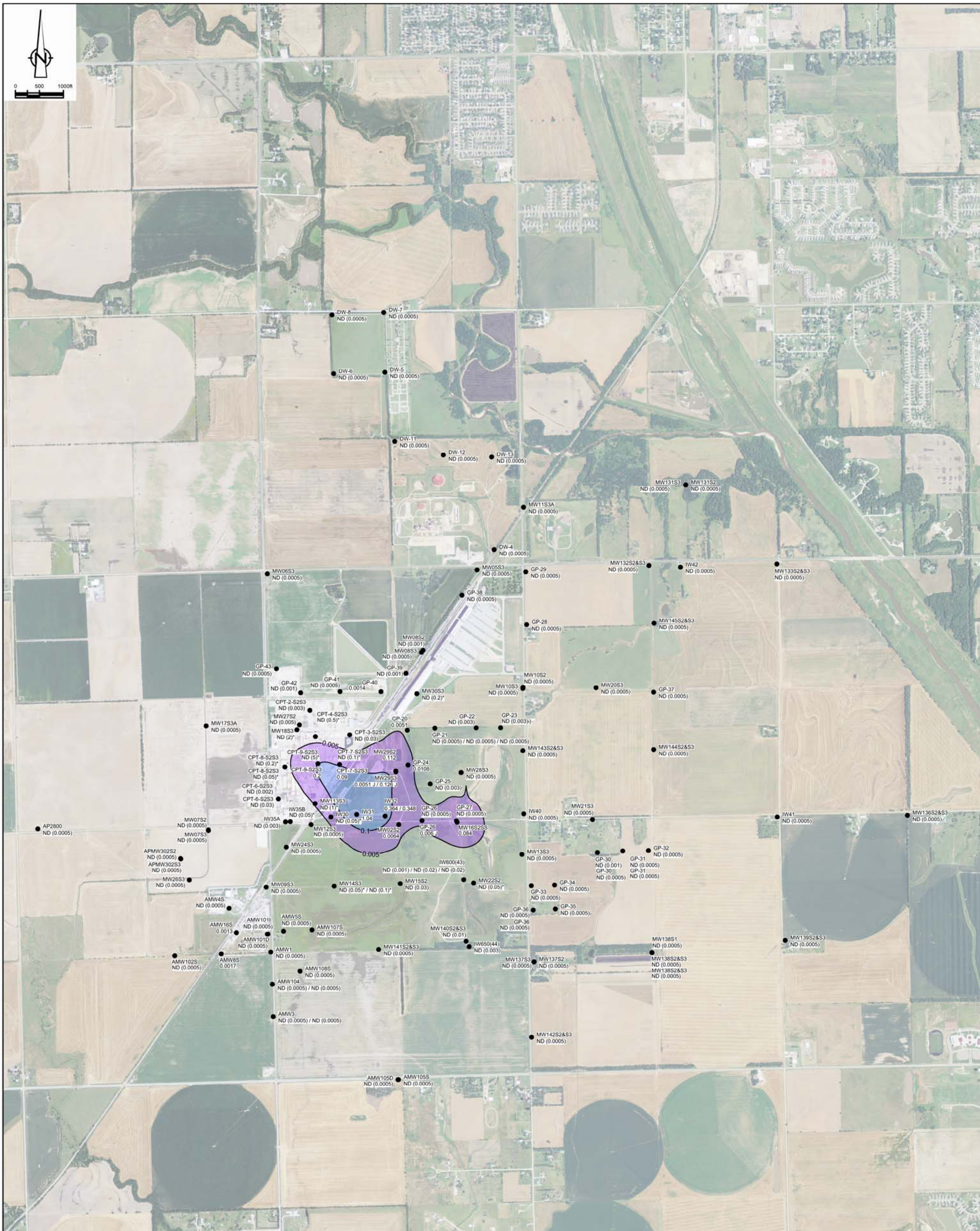
CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:
B. CLEGG	S. SOUTTER	3/15/13

Scale:	Project Nº:	Report Nº:	Drawing Nº:
1:150	54046-D21111	036	figure I 36

54046-D21111(036)GN-CO093 MAR 15/2013



LEGEND:

0.005	BENZENE ISOCONCENTRATION CONTOUR IN mg/L
AMW1 ● ND (0.00005)	MONITORING WELL LOCATION AND IDENTIFIER GROUNDWATER SAMPLE RESULT mg/L
ND (0.00005)	NOT DETECTED
*	AVERAGE VALUE OF CO-LOCATED RESULTS
^	ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

GROUNDWATER CRITERIA			
CHEMICAL NAME	MCL	TAP WATER	UNITS
BENZENE	0.005	0.00039	mg/L

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

NOTES:

1- ISCONCENTRATION CONTOURS WERE GENERATED BASED ON THE MAY 2012 GROUNDWATER SAMPLING EVENT, THE MAY 2012 CPT GROUNDWATER SAMPLING, AND THE SEPTEMBER 2012 GEOPROBE SAMPLING REPRESENTATIVE OF THE S2/S3 AQUIFER USING SURFER 7, LOG10 TRANSFORMED DATA, HALF THE MEDIAN LIMIT FOR NON-DETECTION VALUES, LINEAR 1:1 VARIOGRAM WITH ANISOTROPY OF 1.5 AT 135°, AND LINEAR DRIFT.

2- RESIDENTIAL WELL DATA INCLUDED IN ISONCENTRATION CONTOURS BUT POINT CONCENTRATIONS NOT SHOWN ON FIGURE.

Nº	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

BENZENE ISOCONCENTRATION CONTOURS IN S2/S3 GROUNDWATER AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOURS

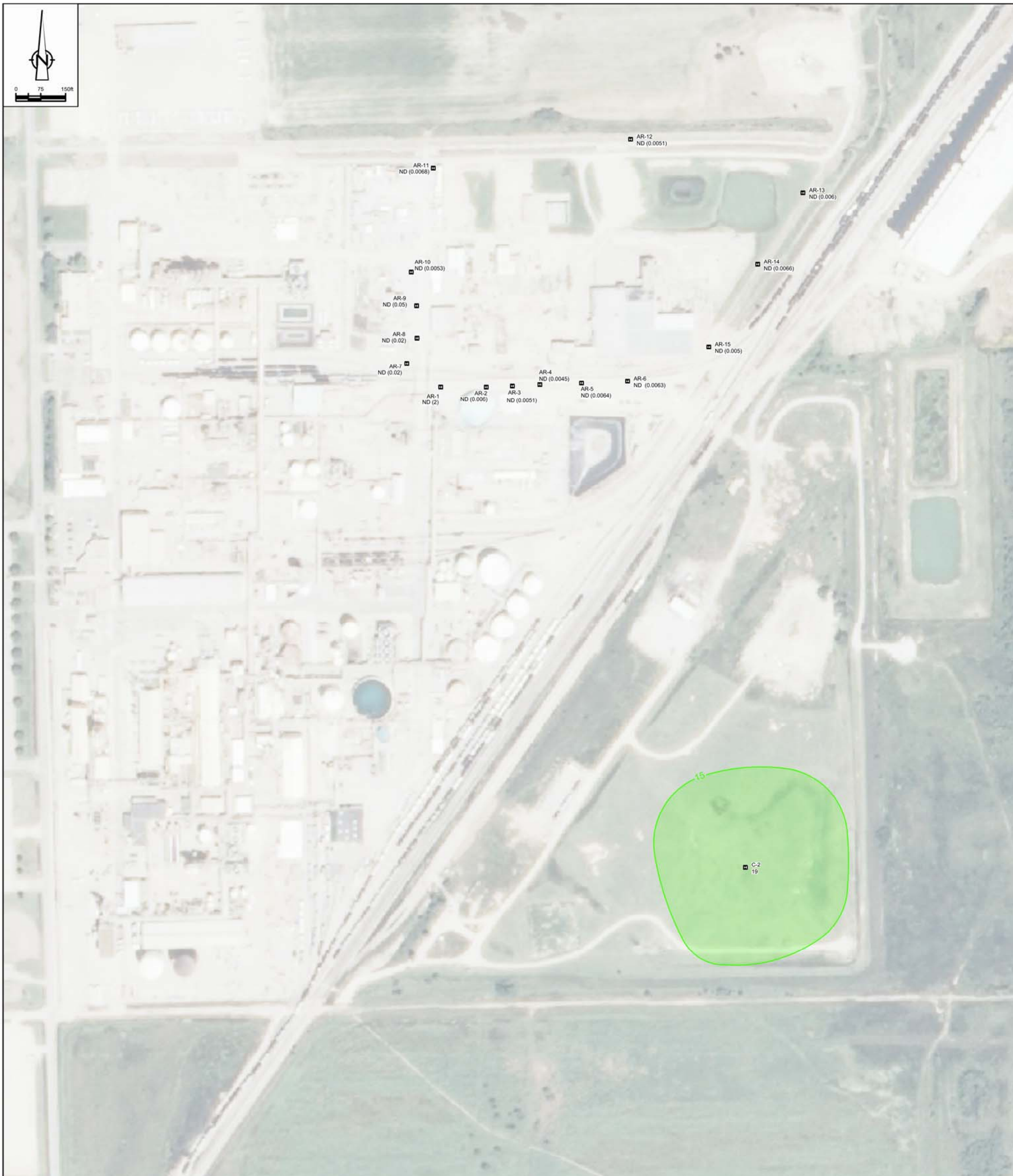
OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:	
B. CLEGG	S. SOUTTER	3/15/13	
Scale:	Project Nº:	Report Nº:	Drawing Nº:
#####	54046-D21111	036	figure I 37

54046-D21111(036)GN-CO072 MAR 15/2013



LEGEND:

TOLUENE ISOCONCENTRATION CONTOUR IN mg/kg

AR-1 ND (2) — SOIL SAMPLE LOCATION AND IDENTIFIER / SOIL SAMPLE RESULT

ND — NOT DETECTED

★ — AVERAGE VALUE OF CO-LOCATED RESULTS

^ — ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

CHEMICAL NAME	INDUSTRIAL SOIL	UNITS
TOLUENE	45,000	mg/kg

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

№	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

TOLUENE ISOCONCENTRATION
CONTOURS IN SOIL
ANALYTICAL RESULTS USED TO GENERATE
ISOCONCENTRATION CONTOUR

OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

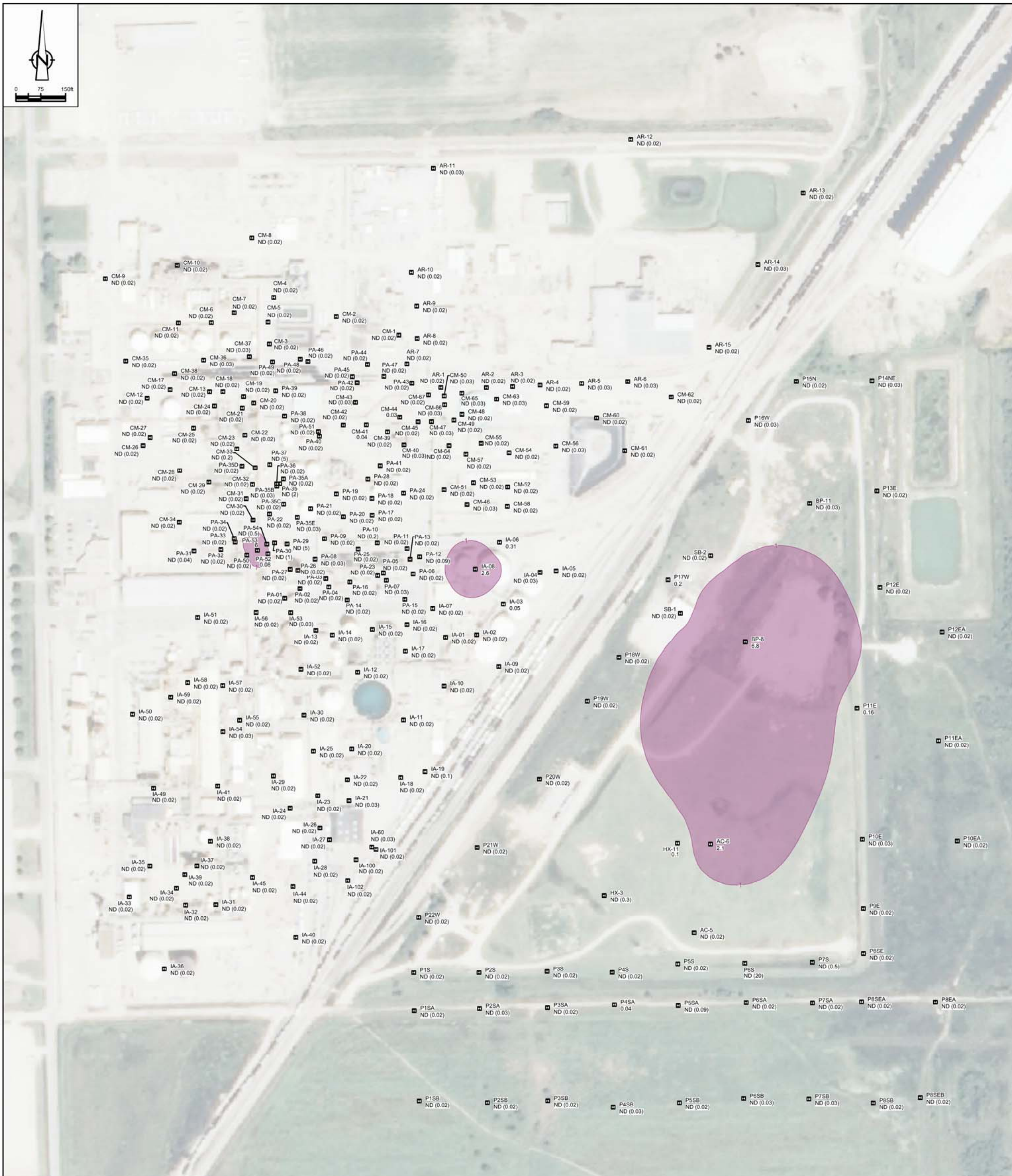
CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager: B. CLEGG | Reviewed By: S. SOUTTER | Date: 3/7/13

Scale: 1:150 | Project №: 54046-D21111 | Report №: 036 | Drawing №: figure I 38

54046-D21111(036)GN-CO103 MAR 15/2013



LEGEND:

1 2,4-DICHLOROPHENOXYACETIC ACID ISOCONCENTRATION CONTOUR IN mg/kg

CM-1 ND (0.02) SOIL SAMPLE LOCATION AND IDENTIFIER SOIL SAMPLE RESULT

ND NOT DETECTED

* AVERAGE VALUE OF CO-LOCATED RESULTS

^ ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

CHEMICAL NAME	INDUSTRIAL SOIL	UNITS
2,4-DICHLOROPHENOXYACETIC ACID	7,700	mg/kg

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

Nº	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

2,4-DICHLOROPHENOXYACETIC ACID ISOCONCENTRATION CONTOURS IN SOIL AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOUR

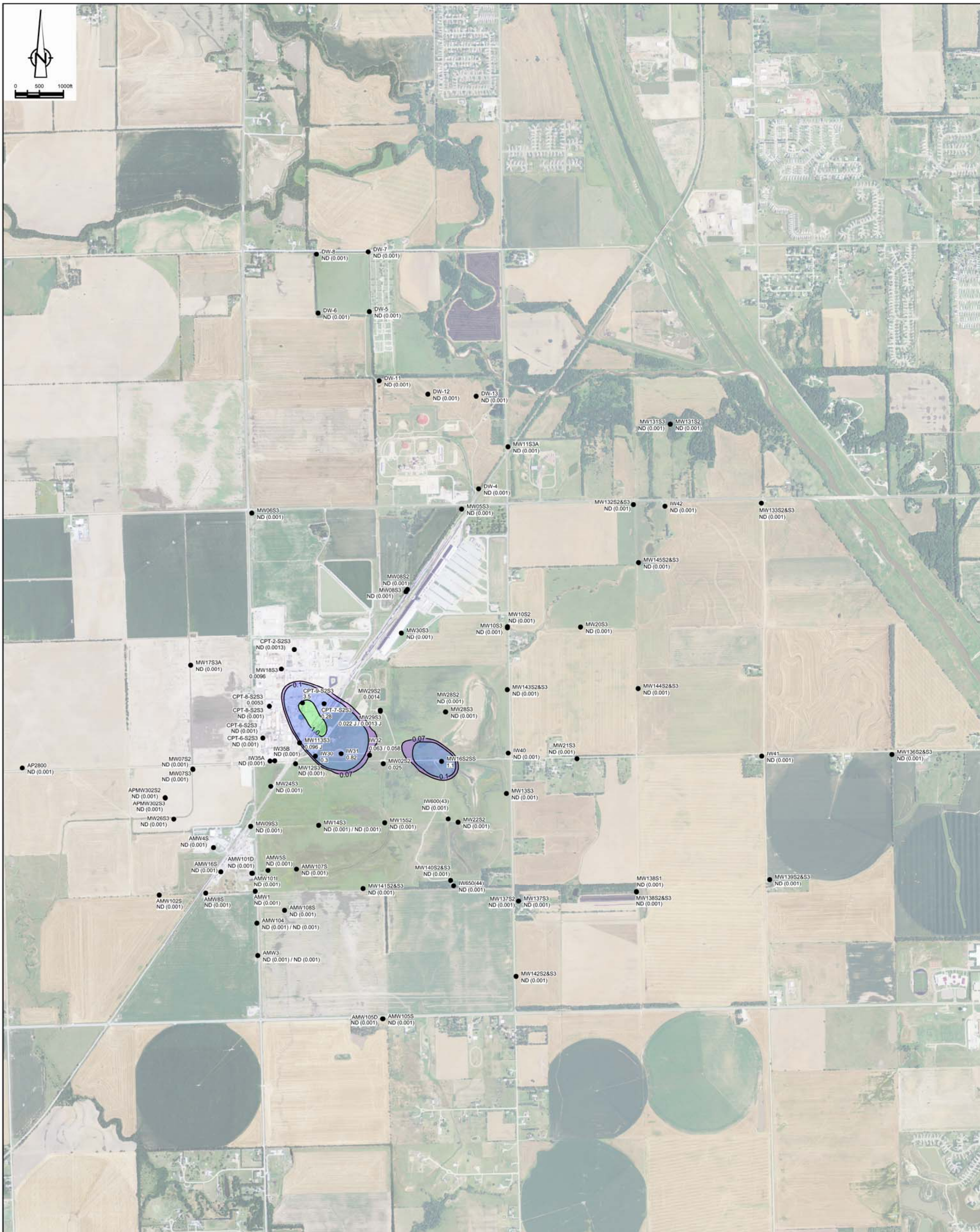
OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:
B. CLEGG	S. SOUTTER	3/15/13
Scale: 1:150	Project Nº: 54046-D21111	Report Nº: 036 / Drawing Nº: figure I 39

54046-D21111(036)GN-CO090 MAR 15/2013



LEGEND:

0.007 2,4-DICHLOROPHENOXYACETIC ACID ISOCONCENTRATION CONTOUR IN mg/L

AMW1 ND (0.0001) ● MONITORING WELL LOCATION AND IDENTIFIER GROUNDWATER SAMPLE RESULT mg/L

ND (0.0001) NOT DETECTED

* AVERAGE VALUE OF CO-LOCATED RESULTS

^ ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

GROUNDWATER CRITERIA			
CHEMICAL NAME	MCL	TAP WATER	UNITS
2,4-DICHLOROPHENOXYACETIC ACID	0.07	0.13	mg/L

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

NOTES:

1- ISCONCENTRATION CONTOURS WERE GENERATED BASED ON THE MAY 2012 GROUNDWATER SAMPLING EVENT, THE MAY 2012 CPT GROUNDWATER SAMPLING, AND THE SEPTEMBER 2012 GEOPROBE SAMPLING REPRESENTATIVE OF THE S2/S3 AQUIFER USING SURFER 7, LOG10 TRANSFORMED DATA, HALF THE MEDIAN LIMIT FOR NON-DETECTION VALUES, LINEAR 1:1 VARIOGRAM WITH ANISOTROPY OF 1.5 AT 135°, AND LINEAR DRIFT.

2- RESIDENTIAL WELL DATA INCLUDED IN ISONCENTRATION CONTOURS BUT POINT CONCENTRATIONS NOT SHOWN ON FIGURE.

No	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

2,4-DICHLOROPHENOXYACETIC ACID ISOCONCENTRATION CONTOURS IN S2/S3 GROUNDWATER AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOURS

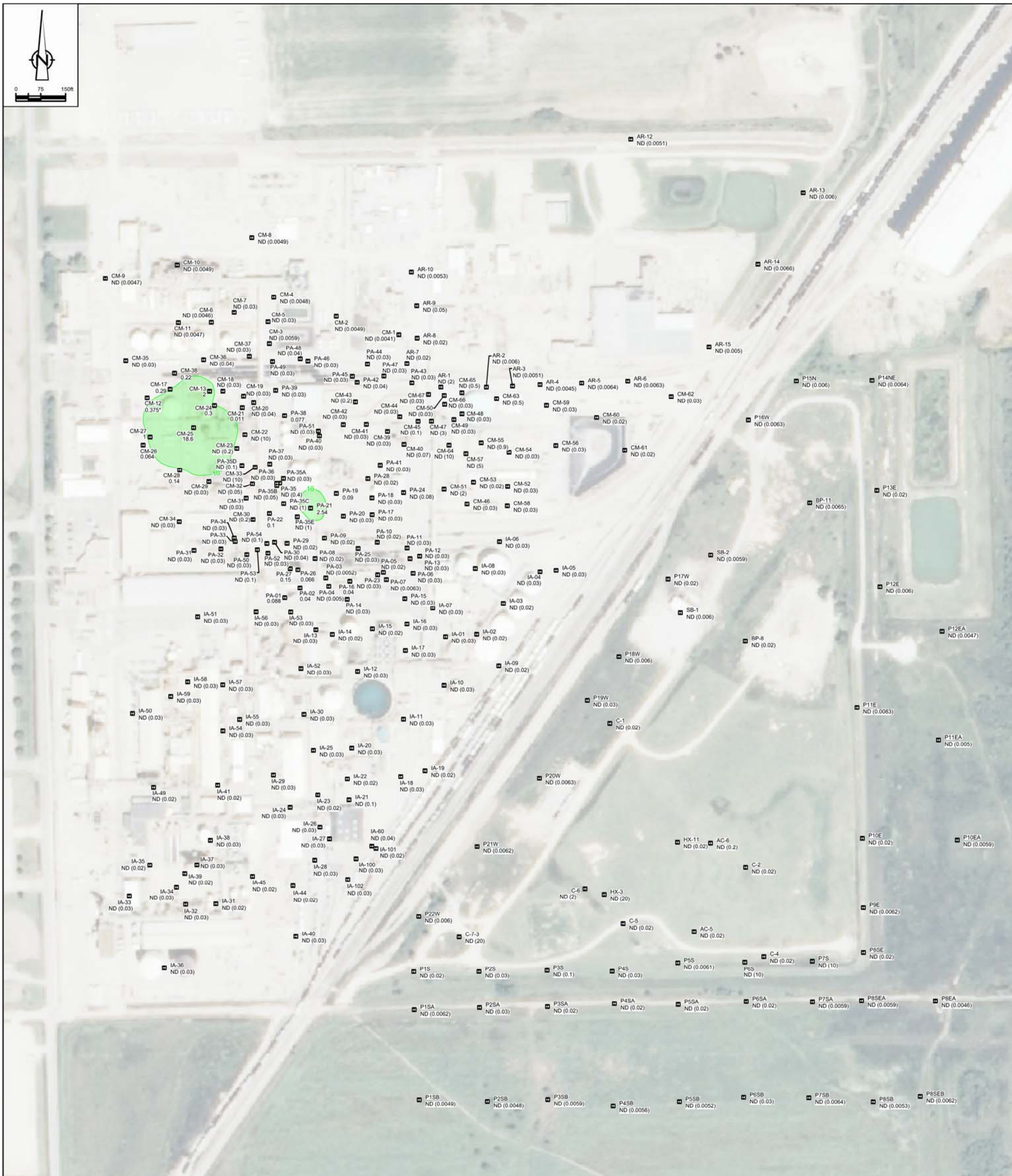
OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:	
B. CLEGG	S. SOUTTER	3/15/13	
Scale:	Project No:	Report No:	Drawing No:
#####	54046-D21111	036	figure I 40

54046-D21111(036)GN-CO069 MAR 15/2013



LEGEND:

10 — 1,2-DICHLOROPROPANE ISOCONCENTRATION CONTOUR IN mg/kg

CM-1 ND (0.0041) — SOIL SAMPLE LOCATION AND IDENTIFIER SOIL SAMPLE RESULT

ND — NOT DETECTED

* — AVERAGE VALUE OF CO-LOCATED RESULTS

^ — ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

CHEMICAL NAME	INDUSTRIAL SOIL	UNITS
1,2-DICHLOROPROPANE	4.7	mg/kg

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

Nº	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

1,2-DICHLOROPROPANE ISOCONCENTRATION CONTOURS IN SOIL AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOUR

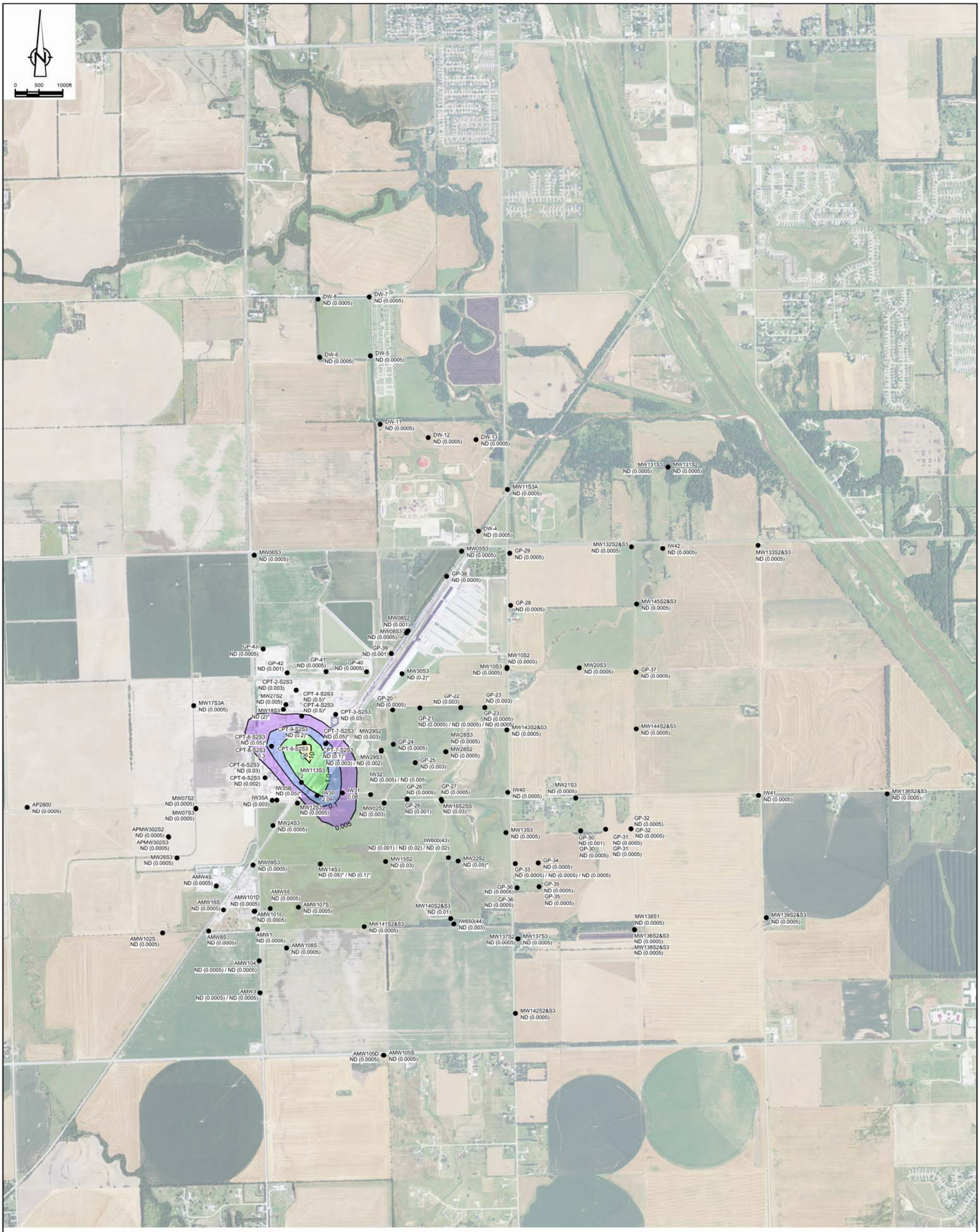
OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:	
B. CLEGG	S. SOUTTER	3/15/13	
Scale: 1:150	Project Nº: 54046-D21111	Report Nº: 036	Drawing Nº: figure I 41

54046-D21111(036)GN-CO085 MAR 15/2013



LEGEND:

0.005	1,2-DICHLOROPROPANE ISOCONCENTRATION CONTOUR IN mg/L
AMW1 ● ND (0.00005)	MONITORING WELL LOCATION AND IDENTIFIER GROUNDWATER SAMPLE RESULT mg/L
ND (0.00005)	NOT DETECTED
*	AVERAGE VALUE OF CO-LOCATED RESULTS
^	ELEVATED NON-DETECT VALUE EXCLUDED FROM THE KRIGING ALGORITHM

GROUNDWATER CRITERIA			
CHEMICAL NAME	MCL	TAP WATER	UNITS
1,2-DICHLOROPROPANE	0.005	0.00038	mg/L

SOURCE: REGIONAL SCREENING LEVEL SUMMARY TABLE, NOVEMBER 2012

NOTES:

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Nº	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

1-2-DICHLOROPROPANE ISOCONCENTRATION CONTOURS IN S2/S3 GROUNDWATER AND ANALYTICAL RESULTS USED TO GENERATE ISOCONCENTRATION CONTOURS

OCCIDENTAL CHEMICAL CORPORATION
WICHITA, KANSAS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:	
B. CLEGG	S. SOUTTER	3/15/13	
Scale:	Project Nº:	Report Nº:	Drawing Nº:
#####	54046-D21111	036	figure I 42

54046-D21111(036)GN-CO065 MAR 15/2013